MASTER
NEGATIVE
NO. 95-82453-2

COPYRIGHT STATEMENT

The copyright law of the United States (Title 17, United States Code) governs the making of photocopies or other reproductions of copyrighted materials including foreign works under certain conditions. In addition, the United States extends protection to foreign works by means of various international conventions, bilateral agreements, and proclamations.

Under certain conditions specified in the law, libraries and archives are authorized to furnish a photocopy or other reproduction. One of these specified conditions is that the photocopy or reproduction is not to be "used for any purpose other than private study, scholarship, or research." If a user makes a request for, or later uses, a photocopy or reproduction for purposes in excess of "fair use," that user may be liable for copyright infringement.

The Columbia University Libraries reserve the right to refuse to accept a copying order if, in its judgement, fulfillment of the order would involve violation of the copyright law.

Author:
Eggleston, De Witt Carl

Title:
Business costs

Place:
New York

Date:
1921

95-82453-2
MASTER NEGATIVE #

COLUMBIA UNIVERSITY LIBRARIES
PRESERVATION DIVISION

BIBLIOGRAPHIC MICROFORM TARGET

ORIGINAL MATERIAL AS FILMED - EXISTING BIBLIOGRAPHIC RECORD

Business
460
Eg352

Eggleston, De Witt Carl.

... Business costs, by De Witt Carl Eggleston ... and Frederick B. Robinson ... New York, London, D. Appleton and company, 1921.

xxx, 587 p. incl. tables, forms, diagrs. 23cm. (The College of the city of New York series in commerce, civics and technology)

1. Cost—Accounting. I. Robinson, Frederick Bertrand, 1883– joint author. II. Title.

Library of Congress HF5686.C8E3 21–4822

—— —— Copy 2.

Copyright A 611234 [5]

RESTRICTIONS ON USE:

TECHNICAL MICROFORM DATA

FILM SIZE: 35mm REDUCTION RATIO: 12x IMAGE PLACEMENT: IA (IIA) IB IIB

DATE FILMED: 4-5-95 INITIALS: PB

TRACKING # : MSH 05809

FILMED BY PRESERVATION RESOURCES, BETHLEHEM, PA.

2.0 mm ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz1234567890

1.5 mm ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz1234567890

PM-MGP 13"x18"
METRIC GENERAL PURPOSE TARGET
PHOTOGRAPHIC

200 mm

150 mm

100 mm

A4

A5

1.0 mm ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz1234567890

1.5 mm ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz1234567890

2.0 mm ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 1234567890

2.5 mm ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 1234567890

PRECISION℠ RESOLUTION TARGETS

Century

A&P

1303 Geneva Avenue
St. Paul, MN 55119

4.5 mm ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 1234567890

3.5 mm ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz1234567890

D460 E5352
Columbia University
in the City of New York
LIBRARY
School of Business

THE COLLEGE OF THE CITY OF NEW YORK

SERIES IN

COMMERCE, CIVICS AND TECHNOLOGY

A SERIES OF TEXTS BY SPECIALISTS

EDITED BY

FREDERICK B. ROBINSON, A.M., PH.D.
DEAN OF THE SCHOOL OF BUSINESS AND CIVIC ADMINISTRATION
PROFESSOR OF ECONOMICS, COLLEGE OF THE CITY OF NEW YORK

THE COLLEGE OF THE CITY OF NEW YORK
SERIES IN COMMERCE, CIVICS AND TECHNOLOGY

BUSINESS COSTS

BY

DEWITT CARL EGGLESTON, M.E., C.P.A.

ASSISTANT PROFESSOR OF COST ACCOUNTING IN THE COLLEGE OF THE CITY OF NEW YORK; AUTHOR OF "PROBLEMS IN COST ACCOUNTING"

AND

FREDERICK B. ROBINSON, PH.D.

DEAN OF THE SCHOOL OF BUSINESS AND CIVIC ADMINISTRATION AND PROFESSOR OF ECONOMICS IN THE COLLEGE OF THE CITY OF NEW YORK

ILLUSTRATED

D. APPLETON AND COMPANY
NEW YORK LONDON
1921

Bus.
21-10918
4 copies.

COPYRIGHT, 1921, BY
D. APPLETON AND COMPANY

D 460
Eg 352
cop 1

PRINTED IN THE UNITED STATES OF AMERICA

G.S.P.

PREFACE

Those who have rejoiced at the rapidity with which business has taken its place among the professions have recently had occasion to point with pride to the growing body of scientific business literature. Books, periodicals, pamphlets, and special articles in great number, dealing with every aspect of complex modern business, come from the presses every month. Not only is the mass of this literature increasing in a most gratifying manner, but its quality is improving. The writers are no longer amateurs venturing vague suggestions; they are authorities expressing themselves with precision and dealing with difficult matters in competent, professional style. During the last twenty years colleges and universities have trained more and more young men to bring scholarship and the scientific spirit to business. These students have justified their training; they have had a profound and beneficial influence upon industry. By their labors in the business house, in the professorial chair, and in the author's study they have shaped the ideals of the world of work, and they have created a new body of knowledge for that world — a body of ideas expressed in acceptable terminology, organized according to demonstrable principles, and proved in processes of tried technique.

One of the first aspects of business to be brought within fairly generally accepted bounds of scientific agreement was accounting. The Certified Public Accountants and the colleges that trained them were largely responsible. The accountants with their background of schooling considered themselves a professional group with professional standards to maintain; consequently they solidified, protected, and developed the science of accounts. But gradually the executive who had employed bookkeepers, accountants, and auditors to discharge what he considered rather colorless functions of recording began to take a more personal interest in accounting because he came to realize that he had to depend upon the operation of his accounting system for information essential to the effective con-

duct of his business. From interest in the accurate analysis of the results of transactions he passed to inquiry into causes. This soon involved him in the mysteries of business costs. It is in the special field of costs that business methods and accounting systems come together most intimately. For this reason many excellent books and articles have been written on cost accounting, from the standpoint of the general manager who had to be made acquainted with the uses of this "business stethoscope," and also from the standpoint of the accounting expert on costs who has to keep in touch with all new devices and methods to insure greater refinement, reliability, and speed in cost calculations. At first most of the works on cost accounting dealt with factory costs for manufacturing plants of the job-order variety, but gradually attention was paid to other kinds of enterprises until a great mass of permanent and fugitive literature was produced that covered almost every conceivable phase of costing. Nevertheless, there has been hitherto no single, authoritative treatise to cover all the principles of cost accounting for extractive, manufacturing, and mercantile industries with plants of either the continuous-process or the job-order type, and to present methods whereby all the books of the firm could be kept interlocked with a practical cost system in harmony with proved principles.

To meet this need for a comprehensive manual of cost accounting I requested Professor Eggleston of the staff of the College of the City of New York to prepare the material for a text that would be serviceable alike to students and to men already in business as executives or as accountants. It would be difficult to find a person better qualified for the undertaking. Educated as an engineer, Professor Eggleston was able to understand the mechanical processes of production, and as a Certified Public Accountant he was competent to analyze the financial books of any concern. Thoroughly prepared in these two essential branches of knowledge, he spent a number of years as an expert for the United States Tariff Commission, examining the production plants and books of a great many concerns in various lines of industry in order to report on the details of costs that might affect tariff legislation. This experience was subsequently amplified by extensive work as a cost consultant in private practice. Entering upon his task thus well prepared, Professor Eggleston gathered together with characteristic thoroughness all the literature on the subject of cost accounting. As a consequence, this work, which is the result of his efforts, may be considered to be a digest of all available literature on costs in the English language.

But besides gathering together all that had been said on all aspects of cost accounting, Professor Eggleston added contributions that grew out of his own experience and thought. For over three years he worked over this material with his classes in cost accounting at the College of the City of New York, gradually sifting out those illustrations which seemed to be of most service in impressing principles upon students. It has been to me a great pleasure to work with Professor Eggleston in the organization of the wealth of material that he gathered together and selected for his text. As collaborator with him, I must say that he is the author of all the technical material in the book; my services have been confined to matters of exposition, presentation, and organization, and also to an attempt to standardize terminology and to bring the theory of cost accounting into harmony with accepted general principles of economics. This latter object was kept in mind because I have long felt that economists should adopt terms understandable to the business man, and writers on practical business subjects should formulate their principles so as to make clear their relationship to broad economic principles.

It will be observed that considerable care has been taken to present in Part I a fairly comprehensive view of the aims of cost accounting. Each business establishment is looked upon as a business economy with internal problems of organization and with external relationships to the market from which it buys material and services and to which it sells its product. The cost system is regarded as a necessary piece of administrative machinery to enable "the enterpriser to combine the various factors of production in the most advantageous proportions and relationships and to adjust his output to the market so that there will accrue to his business a maximum net return." In Part I, a comprehensive view of the elements of cost, including the general cost formula, is given, the relationship of cost to production is outlined, and a general system of interlocking the cost accounts with the financial books of the firm is set forth.

We have felt it wise to give this comprehensive view of the nature and functions of cost accounting at the outset and then to devote the rest of the book to an orderly and exhaustive presentation of all the details of device and practice that would be met in any situation confronting the cost accountant in any line of business. Besides presenting all the discoverable underlying principles of cost accounting, we have been careful to present a wealth of illustrations and forms of value to the cost accountant. There are in all over two hundred exhibits of this sort. The forms illustrate the most up-to-date practice and they are sufficiently wide in their scope to cover all the requirements of any concern — it being understood, of course, that a reasonable amount of judgment must be used by the reader in modifying them to meet peculiar local conditions.

Great care has also been taken to formulate clear and comprehensive definitions that are adhered to after their initial statement. We have considered it good policy in exposition to lead up to the definitions, rather than to present them at the outset when the reader has little background for their comprehension. To illustrate, we may refer to the definitions of "prime cost" on page 20 and "overhead expense" on page 24 and the manner in which they are developed.

A distinct contribution to the science of cost accounting is made in the bookkeeping that is set forth in this work. Here all the elements of cost are brought together, and the operation of all controling accounts is explained. The interlocking of cost accounts with the financial records is fully set forth. It is here that the science of cost finding reaches its highest development. Obviously, any cost records that do not interlock and fully harmonize with the books of the concern are but crude guides for the executive. The bookkeeping methods whereby the cost data may be checked and controlled by the books of the concern are presented for the first time in this general treatise.

Toward the end of the book several complete cost systems are explained, so that the student may gain a comprehensive grasp of a cost system and understand the way in which it operates as a whole. Many statistical charts are introduced in order to show how cost data can be presented to the busy executive in graphic form. Finally, the most recent developments in association cost-finding

systems are outlined. These last chapters will acquaint the student with the most modern tendencies in the field of cost finding.

We would suggest that teachers using this book for classroom instruction may find it profitable to follow the methods which Professor Eggleston uses in his own classes. After covering the material in Parts I and II of the book, it is his custom to assign to the students readings in the succeeding parts to be carried on concurrently with the solution of assigned problems in his earlier *Problems in Cost Accounting.* The principles presented in this text follow the same sequence as the problems presented in the earlier book. At the College of the City of New York, the cost-accounting class meets once a week for a two-hour session. During the second semester of sixteen weeks the remaining parts in both books could be covered. It is highly desirable that the student should have had instruction of at least a year in general accountancy before he takes up the study of cost accounting; certainly he should have that much instruction and preferably as much again before he undertakes to study the principles set forth in Parts VI and VII of this book. To facilitate review, lists of questions have been appended to each chapter.

If the users of this book discover any important subject or problem in cost accounting not covered by the work, we should be pleased to have our attention directed to the omission. Of course, all works are susceptible of improvement, and we should be most grateful for any suggestions for the improvement of the matter here presented or for any hints concerning the most advantageous way of using this text in the classroom.

FREDERICK B. ROBINSON

CONTENTS

PAGE

PREFACE v

PART I

COST ACCOUNTING

CHAPTER

I. THE PURPOSE OF COST ACCOUNTING 3
1. Profit, the Motive for Business Enterprise 3
2. The Elimination of Waste 4
3. Concealed Losses 5
4. Why Install a Cost System 5
To Segregate Departmental Profits 5
5. To Indicate Lines to Push 6
6. To Determine When to Buy Rather Than to Make an Article or Part 6
7. To Determine Rates in Different Services Physically Combined in an Article or Organization 7
8. To Segregate Departments in Which the Basis of Overhead Apportionment is Different 8
9. To Detect Details of Loss 8
10. To Check the Inventory 8
11. To Apportion Supervision 9
12. To Check Estimates 9
13. Teamwork Among Manufacturers 10
14. Definition of a Cost System 10

II. RELATION OF PROFITS TO COST 12
15. An Illustrative Case 12
16. Inventory Adjustments 13
17. Inventory of Goods on Hand 14
18. Plant Appraisal: Depreciated Value; Depreciation 15
19. Total Cost 16
20. Cost to Make and Selling Expenses 16
21. Relation of Profits to Costs 17
22. Process and Job-Order Plants 17
23. Summary 18

III. ELEMENTS OF COST 20
24. Main Elements and Their Subdivisions 20
25. Raw Materials 20
26. Direct Labor 21
27. Factory Overhead 21
28. Selling Expense 24
29. Variations in the Cost Formula 24
30. Specific Applications of the General Cost Formula 25
31. Cost Determinations by the United States Government . . . 25
32. Cost Formula for Bessemer-Steel Rails 25
33. Cost Formula for Clothing 26
34. Cost Formula for a Weaving Mill 27
35. Engineering and Drafting Expense 27
36. Sources of Cost Data 28

CHAPTER PAGE

IV. Production and Costs . . . 30
37. Production Control . . . 30
38. Continuous-Process Plants . . . 30
39. Job-Order Factories . . . 32
40. Cost Mechanism . . . 34
41. Process Cost System . . . 34
42. Job-Order Cost System . . . 36
43. Summary . . . 38

V. Cost Accounts . . . 40
44. Interlocking Devices . . . 40
45. Chart of Cost Accounts . . . 40
46. Supplies Account . . . 42
47. Raw Material Account . . . 42
48. Work in Process Account . . . 42
49. Overhead Expense Account . . . 42
50. Finished Goods Account . . . 43
51. Cost of Sales Account . . . 43
52. Selling Expense Account . . . 43
53. Factory Ledger . . . 43
54. Method of Controlling the Factory Ledger . . . 44
55. Journal Entries . . . 45
56. Trial Balance of Factory Ledger . . . 47
57. Control of Inventory Accounts . . . 47
58. Raw Material Stores Ledger . . . 47
59. Work in Process Ledger . . . 48
60. Finished Goods Stock Ledger . . . 49
61. Trial Balance . . . 51
62. Balance Sheet . . . 51
63. Profit and Loss Account . . . 53
64. Analysis of Sales . . . 53
65. Summary . . . 54

PART II

PRODUCTION AND COSTS

VI. Production Records . . . 59
66. Relation of Production Records to Cost Finding . . . 59
67. Reports *vs.* Orders . . . 60
68. Card Room Daily Report . . . 60
69. Production Record . . . 62
70. Foundry Daily Production Record . . . 63
71. Automatic Counting . . . 64
72. Production Orders . . . 65
73. Classification of Production Orders . . . 65
74. Production Order for a Printing Factory . . . 66
75. Production Order for Shoes . . . 67
76. Style Number Index Card . . . 69
77. Production Orders in an Ostrich-Plume Factory . . . 71
78. Parts System for a Machine Shop . . . 76
79. Stock List . . . 76
80. Assembly Drawing . . . 77
81. Individual Parts Needed by the Assembly Foreman . . . 77
82. Parts Entering Partial Assemblies . . . 78
83. Raw Material Index . . . 79
84. Operation Index . . . 79
85. Square-Turn Farm Tractor . . . 80
86. Production System in Assembling Industries . . . 81

CHAPTER PAGE

87. Dispatching Orders . . . 82
88. Summary . . . 83

VII. Cost Summary Forms . . . 85
89. Cost Sheets . . . 85
90. Cost Sheet for Shoes . . . 86
91. Individual Order Cost Sheet . . . 87
92. Cost Summary Form for Separate Burden Application . . . 89
93. Cost Summary Form for Machine Shops . . . 89
94. Cost Record . . . 89
95. Special Cases . . . 91

PART III

MATERIAL COSTS

VIII. Introduction to Material Costs . . . 95
96. Cost of Material . . . 95
97. Material Cost Calculations . . . 95
98. Loss Due to Waste Material . . . 96
99. Means for Controlling Stores . . . 96
100. Purchasing System . . . 97

IX. Purchasing and Voucher System . . . 99
101. Purchasing Agent . . . 99
102. Purchase Specifications . . . 99
103. Purchasing Records . . . 100
104. Quotation Record . . . 101
105. Vendors' Record . . . 101
106. Catalogues and Discount Sheets . . . 102
107. Requisition on Purchasing Agent . . . 102
108. Purchase Order . . . 103
109. Petty-Cash Voucher . . . 105
110. Voucher Stamp . . . 105
111. Purchase Journal . . . 106
112. Charge-Back Invoice . . . 107
113. Voucher File . . . 107
114. Liquidating Purchases . . . 109
115. Voucher Checks . . . 109
116. Cash-Paid Book . . . 110
117. Bills-Payable Record . . . 111
118. Daily Cash Report . . . 111
119. Summary . . . 112

X. Stores Organization . . . 114
120. Stores Control . . . 114
121. Material Obtained from Natural Sources . . . 114
122. Material Purchased and Put into Process at Once . . . 115
123. Reserve Stocks of Material . . . 115
124. Reserve Stocks in Broken Lots . . . 116
125. Personnel of the Storehouse . . . 117
126. Fixing Responsibility for Inventory . . . 118
127. Stores Location . . . 118
128. Stores Arrangement . . . 119
129. Waste and Junk . . . 119
130. Storehouse Equipment . . . 120
131. Bin Arrangement in a Store Room . . . 120
132. Special Containers . . . 120
133. Counting Machines . . . 121

CHAPTER PAGE

134. Automatic Scale . . . 121
135. Identification of Stores . . . 121
136. Stores Directory . . . 121
137. Maximum and Minimum Limits . . . 122
138. Stores Turnover . . . 122
139. Waste, Breakage, and Leakage . . . 123
140. Stores Expense . . . 123
141. Summary . . . 124

XI. Stores Classification . . . 125
142. Stores Symbols . . . 125
143. Mercantile Storeskeeping . . . 125
144. Classification Systems . . . 126
145. Numerical Code: Block System . . . 126
146. Numerical Code: Dewey Decimal System . . . 126
147. Uses of the Decimal Point . . . 128
148. Mnemonic Symbols . . . 128
149. Combination of Letters and Numbers . . . 129
150. Stores Catalogue . . . 130
151. Uses of a Code . . . 131
152. Summary . . . 131

XII. Typical Forms and Routine Connected with the Receipt and Issue of Stores . . . 132
153. Requests for Stock . . . 132
154. Receiving Record . . . 132
155. Reports of Stores Issued to Factory . . . 133
156. Recording of Stock Issued . . . 134
157. Storeskeeper's Daily Report of Stock Issued . . . 135
158. Report of Cotton Opened . . . 135
159. Record of Raw Hides Issued . . . 136
160. Requisition . . . 137
161. Stock Memorandum . . . 138
162. Cutting-Room Record of Linings . . . 138
163. Memorandum of Heels . . . 139
164. Dimension List . . . 140
165. Distribution of Material . . . 141
166. Raw Material Returned to Stock . . . 142
167. Summary . . . 142

XIII. Perpetual Inventories: Stores Accounts . . . 144
168. Stores Ledger . . . 144
169. Numerical *vs.* Alphabetical Arrangement . . . 144
170. Cards *vs.* Loose-Leaf Stock Records . . . 145
171. Money Cost Shown on Stock Records . . . 146
172. Location of Stores Ledgers . . . 147
173. Lot Number System . . . 147
174. Upper Leather Tag . . . 148
175. Bin Tag . . . 148
176. Stock Record Showing Quantities Only . . . 149
177. Raw-Stores Record for Lots . . . 150
178. Finished-Goods Stock Record Showing Quantity and Amount . 151
179. Stock Record with Paid-Duty Feature . . . 152
180. Desk Containing Stores Ledger Cards . . . 152
181. Records of Small Tools . . . 152
182. Summary . . . 154

XIV. Physical Inventories . . . 156
183. Inventory Date . . . 156
184. Preliminary Steps . . . 156

CHAPTER PAGE

185. Inventory Tags . . . 157
186. Inventory of Supplies . . . 157
187. Inventory Sheet with Coupon . . . 159
188. Inventory of Sole Leather in Process . . . 160
189. Inventory Instructions . . . 161
190. Pricing the Inventory . . . 162
191. Summary . . . 163

XV. Rebates, Shrinkages, and Margins of Error in Calculating Material Costs Peculiar to Special Industries . . . 164
192. Cost Formula for Material . . . 164
193. Cost of Raw Material . . . 164
194. Containers and Coverings . . . 165
195. Scraps and Cuttings . . . 165
196. Refinings . . . 165
197. Invisible Waste . . . 165
198. Waste in Cutting Lumber . . . 166
199. By-Products . . . 166
200. Yield . . . 167
201. Junk Department Expense . . . 168
202. Gain in Weight . . . 168
203. Loss and Gain on Estimates . . . 168
204. Sorting and Grading Material . . . 170
205. Cost of Material Mined or Quarried . . . 170
206. Take-Up in Weaving . . . 170
207. Take-Up in Twisting Rope . . . 171
208. Mixtures . . . 171
209. Cloth Organizations . . . 172
210. Textile Calculations . . . 173
211. Summary . . . 173

XVI. Cost Arithmetic Connected with Material Expenditures . . 175
212. Need for Accurate Data Regarding Material . . . 175
213. Grading Material . . . 175
214. Conversion Factors . . . 176
215. Cost of Dressed Goods . . . 177
216. Repricing Graded Material . . . 178
217. Alligation . . . 179
218. Waste Products in Handling Non-Ferrous Metals . . . 181
219. Invisible Waste . . . 182
220. Waste Products in Woolen and Worsted Mills . . . 182
221. By-Products . . . 183
222. Percentage of Gain, Loss, and Yield . . . 184
223. Cost of Yield . . . 185
224. Remnants . . . 187
225. Take-Up in Weaving . . . 187
226. Textile Calculations . . . 187
227. Summary . . . 190

PART IV

LABOR COSTS

XVII. Introduction to Labor Costs . . . 195
228. The Element of Labor Cost . . . 195
229. Time Work . . . 195
230. Piecework . . . 196
231. Payrolls . . . 196
232. Distribution of Time in Process Plants . . . 196

CHAPTER PAGE

233. Distribution of Time in Job-Order Factories . . . 197
234. Time-Recording Devices . . . 198
235. Factory Organization . . . 198

XVIII. Departmentalization of the Payroll . . . 199
236. Classification of the Payroll . . . 199
237. Departmentalization . . . 200
238. Examples of Departments . . . 201
239. Organization Charts . . . 201
240. Organization Chart for a Silk-Throwing Mill . . . 202
241. Organization Chart for Job-Order Printery . . . 203
242. Organization Chart for a Jewelry Manufacturing Establishment 204
243. Organization Chart for a Machine Shop and Assembling Plant 206
244. Organization Chart for a Worsted Mill . . . 207
245. Summary . . . 208

XIX. Systems of Wage Payment . . . 209
246. Labor Cost Calculations . . . 209
247. Hour-Rate System . . . 210
248. Overtime . . . 210
249. Piecework System . . . 211
250. Taylor Differential Wage Rate System . . . 213
251. Halsey Premium Wage System . . . 214
252. Rowan Premium Wage System . . . 216
253. Gantt Task and Bonus System . . . 217
254. Emerson Efficiency Bonus System . . . 218
255. Summary . . . 219

XX. Payrolls . . . 221
256. Calculation of Employees' Earnings . . . 221
257. Functions of a Timekeeping System . . . 221
258. Employee's Information Blank . . . 222
259. Employee's Application and Record Form . . . 222
260. Employee's History Card . . . 223
261. Timekeeping Systems in General Use . . . 223
262. Card Time Recorder . . . 223
263. Clock Number Card . . . 225
264. Time-Clock Cards . . . 225
265. Dial Time Recorder . . . 226
266. Payroll . . . 226
267. Payroll Strip . . . 227
268. Piecework Records . . . 228
269. Employee's Piecework Record, Front and Back . . . 229
270. Checking Card . . . 230
271. Piecework Ticket with Coupon . . . 231
272. Piecework Card . . . 232
273. Working Sheet . . . 232
274. Advance Wage Vouchers . . . 233
275. Payrolls . . . 234
276. Payroll Sheet Showing Overtime . . . 234
277. Addressograph . . . 236
278. Payroll . . . 236
279. Payroll Analysis Sheet . . . 238
280. Payroll Analysis . . . 238
281. Summary . . . 239

XXI. Labor Costs . . . 241
282. Labor Cost Records . . . 241
283. Daily Time Sheets *vs.* Individual Job Cards . . . 241
284. Daily Time Report . . . 241

CHAPTER PAGE

285. Individual Job Time Ticket . . . 242
286. Decimal System of Time Recording . . . 243
287. Operative's Time Ticket . . . 244
288. Individual-Job Time Ticket . . . 245
289. Mechanical Aids . . . 247
290. Electric Time Stamp . . . 247
291. Job Time Ticket . . . 249
292. Daily Time Ticket . . . 249
293. Calculagraph . . . 250
294. Calculagraph Time Card . . . 250
295. Operative's Time Record . . . 251
296. Weekly Operation Report, Coats . . . 252
297. Summary . . . 253

XXII. Cost Arithmetic Connected with Labor Expenditures . . . 255
298. Local Conditions Affecting Cost Calculations . . . 255
299. Slide Rule for Reducing Regular Time, Over-Time, and Double Time to Single Hours . . . 255
300. Payroll Calculation Sheet . . . 257
301. Payroll Calculation Sheet . . . 258
302. The Calculus . . . 258
303. Piecework Rates . . . 258
304. Taylor Differential Piece Rate System . . . 264
305. Halsey Premium Wage System . . . 265
306. Rowan Premium Wage System . . . 266
307. Gantt Task and Bonus System . . . 267
308. Emerson Efficiency Wage System . . . 269
309. Summary . . . 270

PART V

OVERHEAD EXPENSE

XXIII. Introduction to Overhead Expense . . . 273
310. Expense and Expense Accounts . . . 273
311. Departmentalization of Expense . . . 274
312. Conversion Costs . . . 275
313. Overhead in Job-Order Factories . . . 275
314. Departmental Rates . . . 276
315. Service Departments . . . 276
316. Selling Expense . . . 277
317. Chart of Expense Account Classifications . . . 277
318. Prepaid and Accrued Charges . . . 279
319. Subsidiary Expense Ledger . . . 279
320. Accounting Periods . . . 279
321. Basis of Expense Accounting . . . 281
322. Unused Capacity . . . 282
323. Accounting Control . . . 283
324. Summary of Principles . . . 284

XXIV. Current Charges to Overhead Expense . . . 285
325. Analysis of Expense . . . 285
326. Indirect Labor . . . 285
327. Purchases Chargeable Directory to Expense . . . 286
328. Supplies Issues Chargeable to Expense . . . 287
329. Production Charged to Expense . . . 288
330. Miscellaneous Charges and Credits to Expense . . . 289
331. Summary . . . 289

CHAPTER PAGE

XXV. Prepaid and Accrued Charges to Overhead Expense 291
332. Fixed Charges 291
333. Expired Capital Outlay 291
334. Plant Ledger 292
335. Machinery Record 293
336. Plant Records 293
337. Depreciation 294
338. Methods of Calculating Depreciation: Fixed Proportion Method 296
339. Fixed Percentage on Diminishing Value Method 297
340. Sinking-Fund Method 301
341. Depletion 304
342. Leasehold Property 305
343. Major Repairs 305
344. Copyrights 306
345. Patents 306
346. Trademarks and Brands 306
347. Goodwill 306
348. Insurance Record 307
349. Taxes 309
350. Schedule of Fixed Charges 311
351. Bookkeeping for Prepaid and Accrued Charges 311
352. Machinery Account 311
353. Plant Valuation 312
354. Depreciation Fund 312
355. Insurance Prepaid Account 313
356. Taxes Prepaid or Accrued Account 313
357. Summary 314

XXVI. Interest 315
358. Profit 315
359. Turnover 315
360. Investment Yield 316
361. Plant Values 316
362. Interest and Rent 316
363. Comparisons with Cost of Outside Service 317
364. Interest May Not be Included in the Balance Sheet 317
365. Summary 318

XXVII. Apportionment of Miscellaneous Services to Operating Departments 319
366. Service Departments 319
367. Repairs 319
368. Power 319
369. Building and Occupancy Expense 320
370. Charts Showing Floor Space Used 320
371. Lighting Expense 322
372. Heating Expense 323
373. Transport Service 323
374. General and Office Expense 323
375. Detailed Analysis of Expense 325
376. Statement of Expense 327
377. Summary 327

XXVIII. Distribution of Overhead Expense to the Product 329
378. Factory Burden 329
379. Distribution of Overhead in Process Plants 329
380. Distribution of Overhead in Job-Order Factories 330
381. Percentage on Productive-Labor Method 330
382. Productive-Hours Method 333

CHAPTER PAGE

383. Percentage on Prime Cost Method 334
384. Sold-Hours Method 335
385. Production-Center Method (Machine Hours) 337
386. Quantity of Output Method 340
387. Selling Expense 341
388. Summary 341

XXIX. Cost Arithmetic Connected with Burden Rate Calculations 343
389. Illustrative Examples 343
390. Hourly Burden Rates in an Optical Goods Factory 343
391. Purchases Chargeable to Expense 344
392. Productive Labor 344
393. Spoilage and Lost Time 345
394. Depreciation 345
395. Insurance and Taxes 345
396. Distribution of Fixed Charges 345
397. Rent 346
398. Power and Light 347
399. Factory Administration 348
400. Hourly Burden Rates 349
401. Percentage of Labor Burden Rates 350
402. Sold-Hours Burden Rates 351
403. Analysis of Hourly Machine Expense 351
404. Summary 353

XXX. The Average Number System of Finding Cotton Yarn Costs . . 354
405. Short Cut Method for Cotton Yarn Costs 354
406. Conversion Cost of the Average Number of Yarn Spun . . . 354
407. Conversion Cost of the Average Number of Yarn Spooled . . 356
408. Conversion Cost of the Average Number of Yarn Twisted . . 358
409. Conversion Cost of the Average Number of Yarn Reeled . . 359
410. Conversion Cost of the Average Number of Yarn Warped . . 360
411. Appreciating the Values of the Cotton in Yarn 361
412. Cost of Yarn Manufactured 362
413. Proof of Accuracy of Yarn Computations 362

PART VI

COLLECTING AND RECORDING COST DATA

XXXI. Introduction to Collecting and Recording Cost Data . . . 367
414. Cost of a Unit of Production 367
415. Manufacturing Section of Profit and Loss Account 368
416. Trading Section of Profit and Loss Account 368
417. Book Inventories 369
418. Balance Sheet and Administrative Reports 369

XXXII. Cost of Manufacture 370
419. Costs in Continuous-Process Plants 370
420. Costs in Job-Order Factories 372
421. Work in Process Controlling Account — Job-Order Cost System 377
422. Departmental Process Controlling Account — Process Cost System 378
423. Finished Goods Controlling Account 380
424. Summary 382

CHAPTER PAGE

XXXIII. Analysis of Sales . . . 383
425. Cost of Sales . . . 383
426. Gross Profit . . . 383
427. Billing and Charge System . . . 384
428. Shipping Order . . . 385
429. Invoice Forms . . . 385
430. Manifold Order System . . . 385
431. Customer's Ledger . . . 387
432. Sales Book . . . 387
433. Recapitulation of Sales . . . 388
434. Sales Analysis . . . 388
435. Summary . . . 388

XXXIV. Subsidiary Factory Ledger . . . 390
436. Factory-Ledger Control . . . 390
437. Trial Balance . . . 390
438. Journal Entries . . . 392
439. *Pro Forma* Ledger Accounts . . . 392
440. Internal Factory Transactions . . . 394
441. Summary . . . 394

XXXV. Financial Statements . . . 396
442. Relation of Cost System to Financial Statements . . . 396
443. Trial Balance . . . 396
444. Balance Sheet . . . 397
445. Profit and Loss Account . . . 397
446. Balance Sheet, Account Form . . . 399
447. Balance Sheet, Report Form . . . 400
448. Profit and Loss Account, Account Form . . . 401
449. Trading and Profit and Loss Account, Report Form . . . 402
450. Complete Set of Financial Statements . . . 402
451. Summary . . . 406

XXXVI. Mechanical Aids in Cost Work . . . 408
452. Devices for Mathematical Calculations . . . 408
453. Comptometer . . . 408
454. Adding and Listing Machines . . . 409
455. Punch Card . . . 410
456. Stores Issued Punch Card . . . 411
457. Labor Punch Card . . . 414
458. Key Punch . . . 415
459. Punching Machine . . . 415
460. Proof of Accuracy in Punching . . . 416
461. Automatic Sorting Machine . . . 416
462. Automatic Tabulating Machine . . . 416
463. Tabulator-Printer . . . 417
464. Summary . . . 418

XXXVII. Graphic Charts . . . 419
465. Visualizing Cost Data . . . 419
466. Ratio Charts . . . 419
467. Special Charts . . . 420
468. Chart Showing Total Payroll Hours in a Cylinder-Press Department . . . 420
469. Chart Showing Chargeable, Non-Chargeable, and Total Hours in a Hand-Composing Room . . . 422
470. Chart Showing Labor and Expense per Yard in a Weaving Mill 423
471. Chart Showing Average Selling Price per Pound and Average Cost of Sales per Pound in a Silk-Throwing Mill . . . 424

CHAPTER PAGE

472. Ratio Charts in General . . . 425
473. Table of Logarithms of Numbers . . . 426
474. Ratio Chart Showing Production, Sales, and Operating Profits 427
475. Ratio Chart Showing Production, Labor, and Expense . . . 428
476. Ratio Chart Showing Hours, Payroll, and Average Amount of Payroll per 1,000 Hours . . . 428
477. Ratio Chart Showing Make-Ready, Running Time and Total Impressions, and Average Impressions per Hour . . . 430
478. Ratio Chart Showing Pounds of Cotton Purchased, Amount Paid for Cotton, and Average Price per 100 Pounds . . . 431
479. Ratio Chart Showing the Days, Payroll, and Number of Papers Printed in the Press Department of a Newspaper . . . 431
480. Ratio Chart Showing Payroll and Hours in Composing Room . 433
481. Ratio Chart Showing Remainder Values Corresponding to Several Fixed Rates of Increase and Decrease per Annum . 435
482. Double Ratio Chart Showing Remainder Values Corresponding to Several Fixed Rates of Increase and Decrease . . . 435
483. Double Ratio Chart Showing the Average Income Corresponding to the Number of Income Tax Returns . . . 437
484. Chart Showing Deviations Above and Below the Moving Average 441
485. Chart Showing Correlation Between Yards Woven and Weaving Labor . . . 442
486. The Normal Curve of Error . . . 442
487. Chart Showing the Normal Curve of Error Based on Newton's Binomial Theorem . . . 445
488. Frequency Chart Showing the Percentage of Employees at Each Five-Dollar Range of Weekly Compensation Compared with the Normal Curve of Error . . . 445
489. Summary . . . 446

PART VII

EXAMPLES OF COMPLETE COST SYSTEMS

XXXVIII. Introduction to Complete Cost Systems . . . 453
490. Study of Conditions Necessary . . . 453
491. Costs in Merchandising Enterprises . . . 453
492. Costs in a Trading Business . . . 453
493. Costs in a Manufacturing Business . . . 454
494. Chart Showing Kind of Cost System Usually Used in Different Industries . . . 454
495. Costs in a Process Plant . . . 456
496. Costs in a Job-Order Plant . . . 456
497. Estimated Costs . . . 456
498. Textile Costs . . . 456
499. Silk-Mill Problem . . . 457
500. Summary . . . 457

XXXIX. Cost Accounts of a Trading Enterprise . . . 458
501. Analysis of Sales . . . 458
502. Gross Profit on Trading . . . 458
503. Candied Citron and Peel Company's Accounts . . . 458
504. Purchase Order and Order Censor . . . 459
505. Shipping Order . . . 459
506. Requisition . . . 459
507. Stock Record . . . 461
508. Pricing System . . . 462
509. Invoice . . . 462
510. Sales Analysis . . . 463
511. Cost of Sales Analysis . . . 463

CHAPTER PAGE

512. Analysis of Gross Profit on Sales . . . 464
513. Journal Voucher . . . 464
514. The General Ledger . . . 466
515. Trial Balance . . . 466
516. Trading and Profit and Loss Account . . . 467
517. Balance Sheet . . . 468
518. Summary . . . 468

XL. Cost Accounts in Continuous-Process Factories . . . 469
519. Unit Costs . . . 469
520. Single and Multi-Process Factories . . . 469
521. Theoretical Production . . . 469
522. Departmental Processes . . . 470
523. Manufacture of Prepared Cocoanut . . . 470
524. Accounting Organization . . . 471
525. Stores Ledger . . . 473
526. Raw-Material Report . . . 474
527. Payroll Distribution . . . 474
528. Burden Analysis . . . 475
529. Manufacturing Cost Analysis . . . 476
530. Goods Packed and Supplies Used . . . 477
531. Cost of Sales . . . 478
532. Journal . . . 479
533. General Ledger Cost Accounts . . . 479
534. Trial Balance . . . 481
535. Balance Sheet . . . 482
536. Profit and Loss Accounts . . . 482
537. Analysis of Sales . . . 483
538. Selling Expense . . . 484
539. Summary . . . 484

XLI. Cost Accounts in Job-Order Factories . . . 486
540. Mechanical Products . . . 486
541. Miscellaneous Jobbing Plants . . . 486
542. Job-Printery Costs . . . 487
543. "Sold Hour" System of Costs . . . 487
544. Printer's Estimate Sheet . . . 488
545. Production Order . . . 489
546. Stores Requisition . . . 489
547. Compositor's Daily Time Ticket . . . 490
548. Pressroom Daily Time Ticket . . . 491
549. Bindery Daily Time Ticket . . . 492
550. Payroll . . . 492
551. Monthly Record of Productive and Non-Productive Hours . . . 493
552. Monthly Record of Productive and Non-Productive Hours and Press Impressions . . . 494
553. Analysis of Hourly Service Costs . . . 496
554. Individual Order Cost . . . 496
555. Inventory of Work in Progress . . . 497
556. Journal Vouchers . . . 497
557. Stores Distribution Journal Voucher . . . 498
558. Labor Distribution Journal Voucher . . . 498
559. Sundry Accounts Journal Voucher . . . 499
560. Burden Distribution Journal Voucher . . . 500
561. Production Journal Voucher . . . 500
562. Cost of Sales Journal Voucher . . . 500
563. Sales Distribution Journal Voucher . . . 501
564. Loss and Gain Journal Voucher . . . 503
565. *Pro Forma* Ledger Accounts . . . 503
566. Loss and Gain Account . . . 507
567. Balance Sheet . . . 507

CHAPTER PAGE

568. Newspaper Costs . . . 508
569. Sales Analysis . . . 508
570. Commodity Classifications . . . 508
571. Summary . . . 509

XLII. Estimating Cost System or Predetermined Job Costs . . . 510
572. Standard Costs . . . 510
573. Costs in Garment and Shoe Factories . . . 510
574. Loss and Gain on Estimates . . . 511
575. A Hypothetical Case . . . 511
576. Factory Profit and Loss . . . 512
577. Cost of Sales . . . 512
578. Standardized Material Sales . . . 512
579. Shoe Factory Accounts . . . 513
580. Cost Sheet . . . 513
581. Shoes Classified . . . 513
582. Shoe-Factory Processes . . . 514
583. Shoe Tag . . . 514
584. Day-Sheet System . . . 514
585. Purchase Journal . . . 516
586. Description of Ledger Accounts . . . 516
587. Trial Balance of Factory Ledger . . . 527
588. Summary . . . 527

XLIII. Textile Costs . . . 528
589. Textile Fibers . . . 528
590. Ply Yarns . . . 528
591. Woven and Knit Fabrics . . . 528
592. Finishing Fabrics . . . 529
593. Process and Job Systems of Production . . . 529
594. Yarn Numbering System . . . 529
595. Organization of Fabrics . . . 530
596. Worsted Mill Costs . . . 530
597. Proved Costs . . . 530
598. Chart of Cost Account Classifications . . . 530
599. Organization Chart . . . 531
600. Payroll Analysis Sheet . . . 532
601. Purchase Journal . . . 532
602. Report of Stores Issued . . . 533
603. Cost of Sorted Wool . . . 533
604. Cost of Tops . . . 534
605. Cost of White Tops . . . 534
606. Cost of Dyed Tops . . . 537
607. Cost of Making Yarn . . . 538
608. Cost of Single Yarn . . . 539
609. Cost of Ply Yarn . . . 540
610. Custom Yarn Costs . . . 541
611. Cost of Making Worsted Fabrics . . . 542
612. Analysis of Sales by Qualities . . . 545
613. Cost Accounts . . . 546
614. Journal Entries . . . 556
615. Summary . . . 560

XLIV. Problem in Process Costs, with Solution . . . 562
616. Silk Mill Costs . . . 562
617. Problem . . . 562
618. Cost of Thrown Silk . . . 574

Index . . . 577

ILLUSTRATIONS

EXHIBITS

PAGE

A. Relation of Profits to Costs 12
B. General Cost Formula 23
C. Process Cost System 35
D. Job-Order Cost System 37
E. Chart of Cost Accounts 41
F. Factory Ledger Control 44
G. Assembly Drawing of Champion Wire Holder 77
H. Individual Part Needed by Assembly Foreman 78
J. Blank Part Entering Partial Assemblies 78
K. Square-Turn Farm Tractor with Plows 81
L. Organization Chart for Throwing Mill 202
M. Organization Chart for Job-Order Printing Plant 203
N. Organization Chart for a Jewelry Manufacturing Establishment 205
P. Organization Chart for a Machine Shop and Assembling Plant 206
Q. Organization Chart for a Worsted Mill 207
R. Chart Showing Amounts Earned Per Hour Corresponding to Time Consumed on Job under Taylor Differential Wage System 214
S. Chart Showing Amounts Earned Per Hour Corresponding to Time Consumed on Job under the Halsey Premium Wage System 215
T. Chart Showing Amounts Earned Per Hour Corresponding to Time Consumed on Job under the Rowan Premium Wage System 216
U. Chart Showing Amounts Earned Corresponding to Time Consumed on Job under the Gantt Task and Bonus System . 217
V. Chart Showing Amounts Earned Per Hour Corresponding to Time Consumed on a Job under the Emerson Efficiency Bonus System 218
W. Calculagraph Time Card 251
X. Slide Rule for Reducing Regular Time, Over-Time and Double Time Worked by an Operative to Single Hours for Payroll Purposes 256
Y. The Calculus 263
Z. Chart of Expense Account Classifications 278
AA. Chart Showing the Depreciated Value at the End of Each Year According to the Fixed Proportion Method 296

PAGE

AB. Chart Showing the Depreciated Value at the End of Each Year According to the Fixed Percentage on Diminishing Value Method 297
AC. Chart Showing the Depreciated Value at the End of Each Year According to the Sinking Fund Method 301
AD. Chart Showing Floor Space Statistics 321
AE. Chart Showing Floor Space Used in a Factory 322
AF. Chart Showing Total Payroll Hours in a Cylinder Press Department 420
AG. Chart Showing Chargeable, Non-Chargeable, and Total Hours in a Hand Composing Room 421
AH. Chart Showing the Labor and Expense Per Yard by Months . 424
AJ. Chart Showing the Average Selling Price Per Pound and the Average Cost of Sales Per Pound 424
AK. Ratio Chart Showing the Production, Sales, Costs, and Operating Profit by Months 428
AL. Ratio Chart Showing the Production, Labor and Expense . . 428
AM. Ratio Chart Showing the Hours, Payroll, and Average Amount of Payroll Per 1,000 Hours 429
AN. Ratio Chart Showing the Make-Ready, Running Time, Total Chargeable Time, Total Impressions, and Average Impressions per Hour of Three Webb Printing Presses 430
AP. Ratio Chart Showing Pounds of Cotton Purchased, Amount Paid for Cotton, and Average Price per 100 Pounds . . 432
AQ. Ratio Chart Showing the Days, Payroll, and Numbers of Papers Printed in the Press Department of a Newspaper . . . 432
AR. Ratio Chart Showing Payroll and Hours in Composing Room 434
AS. Ratio Chart Showing Remainder Values Corresponding to Several Fixed Rates of Increase and Decrease per Annum . 436
AT. Double Ratio Chart Showing Remainder Values Corresponding to Several Fixed Rates of Increase and Decrease . . . 436
AU. Double Ratio Chart Showing the Average Income Corresponding to the Number of Income Tax Returns by Classes . 438
AV. Chart Showing the Deviation Above and Below the Moving Average of Yards Woven and Weaving Labor 441
AW. Chart Showing Correlation between Yards Woven and Weaving Labor 442
AX. Chart Showing the Normal Curve of Error Based on Newton's Binomial Theorem 446
AY. Frequency Chart Showing the Percentage of Employees at Each Five-Dollar Range of Weekly Compensation Compared with the Normal Curve of Error 446
AZ. Chart Showing Kind of Cost System Usually Found in Different Industries 455
BA. General Ledger 465
BB. Accounting Organization Chart 472
BC. Chart of Cost Account Classifications 531

FORMS

FORM PAGE

1. Raw Material Stores Ledger 48
2. Work in Process Ledger 49
3. Finished Goods Stock Ledger 50
4. Trial Balance 50
5. Balance Sheet 51
6. Profit and Loss Account 52
7. Analysis of Sales 53
8. Card Room Daily Report 61
9. Production Record 62
10. Foundry Daily Production Record 63
11. Production Order 66
12. Production Order for Shoes 68
13. Style Number Index 70
14. Dressed Goods Cost Summary 71
15. Requisition on Raw Stores 72
16. Dye House Production Order 72
17. Selector's Copy of Production Order 73
18. Office Copy of Finished Goods Production Order 73
19. Factory Copy of Finished Goods Production Order 74
20. Requisition for Dressed Goods 75
21. Stock List 76
22. Raw Material Index 79
23. Raw Material Index 80
24. Cost Sheet for Shoes 86
25. Individual Order Cost Sheet 88
26. Cost Summary Form for Separate Burden Application . . . 89
27. Cost Summary Form for Machine Shops 90
28. Cost Record 90
29. Quotation Record 101
30. Vendor's Record 102
31. Requisition on Purchasing Agent 103
32. Purchase Order 104
33. Petty Cash Vouchers 105
34. Voucher Stamp 106
35. Purchase Journal for Shoe Factory 107
36. Purchase Journal for Worsted Mill 108
37. Charge Back Invoice 108
38. Voucher Check 109
39. Voucher Check 109
40. Cash Paid Book 110
41. Bills Payable Record 111
42. Daily Cash Report 112

FORM PAGE
43. Receiving Record 133
44. Report of Cotton Opened 135
45. Record of Raw Hides Issued 136
46. Requisition on Storeskeeper 137
47. Stock Memorandum 138
48. Cutting Room Record of Linings Used in Shoe Factory . . . 139
49. Memorandum of Heels Used in Shoe Factory 139
50. Dimension List 140
51. Distribution of Material 141
52. Upper Leather Tag 147
53. Bin Tag 148
54. Stock Record Showing Quantities Only 150
55. Raw Stores Record 151
56. Finished Goods Stock Record 151
57. Stock Record with Paid Duty Feature 153
58. Inventory Tag 158
59. Inventory Tag 158
60. Inventory of Supplies Sheet 159
61. Inventory Sheet with Coupon 160
62. Inventory of Sole Leather in Process 161
63. Table of Conversion Factors 176
64. Cost of Dressed Goods Calculation Sheet 178
65. Table Showing Cost of Tops, Middles and Unders 179
66. Time-Clock Card for Use with Time Recorder 224
67. Time-Clock Card for Use with Time Recorder 224
68. Payroll Strip from Dial Time Recorder 227
69. Employee's Piecework Record 228
70. Employee's Piecework Record for Keeping Memorandum of Weekly Earnings 229
71. Checking Card 230
72. Piecework Ticket with Coupon 231
73. Piecework Card 232
74. Working Sheet 233
75. Payroll 233
76. Payroll 234
77. Payroll Sheet Showing Overtime 235
78. Payroll Written with Addressograph 237
79. Payroll Analysis 239
80. Daily Time Report 242
81. Individual Job Time Tickets 242
82. Operator's Time Ticket 244
83. Individual Job Time Ticket 246
84. Job Time Ticket 247
85. Daily Time Ticket 249
86. Operator's Time Record 252
87. Weekly Operation Report of Costs 253
88. Payroll Calculation Sheet 259
89. Payroll Calculation Sheet 261
90. Machinery Record 292
91. Insurance Record 307

FORM PAGE
92. Insurance Record 308
93. Schedule of Fixed Charges 310
94. Detailed Analysis of Expense 326
95. Statements of Overhead Expense 327
96. Analysis of Hourly Machine Expense 352
97. Invoice to Customer 385
98. Manifold Order 386
99. Recapitulation of Sales 387
100. Sales Analysis 388
101. Punch Card 411
102. Stores Issued Punch Card 412
103. Labor Punch Card 414
104. Purchase Order 459
105. Shipping Order 460
106. Requisition on Stores 460
107. Stock Record 461
108. Invoice to Customer 462
109. Sales Analysis 463
110. Cost of Sales Analysis 463
111. Analysis of Gross Profit on Sales 464
112. Journal Voucher 465
113. General Ledger Trial Balance 466
114. Balance Sheet 467
115. Raw Material Report 474
116. Payroll Distribution 475
117. Burden Analysis 475
118. Manufacturing Cost Analysis 476
119. Goods Packed and Supplies Used 477
120. Cost of Sales 478
121. Journal 479
122. Trial Balance 481
123. Balance Sheet 482
124. Profit and Loss Account 483
125. Analysis of Sales 484
126. Selling Expense 485
127. Estimate Sheet 488
128. Requisition 489
129. Daily Time Ticket, Composition Department 490
130. Daily Time Ticket, Pressroom 491
131. Daily Time Ticket, Bindery 492
132. Payroll, Composition Department 493
133. Monthly Record of Productive and Non-Productive Hours . . 493
134. Monthly Record of Productive and Non-Productive Hours and Press Impressions 494
135. Analysis of Hourly Service Costs 495
136. Inventory of Work in Process 497
137. Stores Distribution Journal Voucher 498
138. Labor Distribution Labor Voucher 499
139. Sundry Accounts Journal Voucher 499

FORM PAGE
140. Burden Distribution Journal Voucher 500
141. Production Journal Voucher 501
142. Cost of Sales Journal Voucher 501
143. Sales Distribution Journal Voucher 502
144. Loss and Gain Journal Voucher 502
145. Loss and Gain Account 507
146. Balance Sheet 508
147. Shoe Tag 515
148. Payroll Analysis Sheet 532
149. Report of Stores Issued 533
150. Cost of Tops, White 535
151. Cost of Tops, Dyed 537
152. Cost of Single Yarn 539
153. Cost of Ply Yarn 540
154. Custom Yarn Costs 541
155. Cost of Worsted 542
156. Analysis of Sales by Qualities 546

PART I

COST ACCOUNTING

BUSINESS COSTS

CHAPTER I

THE PURPOSE OF COST ACCOUNTING

1. **Profit, the Motive for Business Enterprise.**— It is natural that the student should want to know at the very outset just what is meant by cost accounting and just why a practical business man takes the trouble to install and operate a cost system in his establishment. Although a simple and complete definition of cost accounting in the first paragraph of a book would be of little service to the novice, such a definition must be worked out as rapidly as is compatible with clearness. Possibly the best approach to this definition will be through a survey of the general motives that control business executives and through an examination of several cases where such motives operated to dictate the introduction of cost systems.

Of course, it is generally recognized that a particular business man takes up one enterprise or another because he expects to make a profit. Let us say that he decides that the community is in need of fur coats. He believes that he can bring the pelts down from Canada, secure cloth from England, and get other materials from his own neighborhood; that he can pay for the materials, organize designing, cutting, and sewing departments, and meet all the expenses of operating, including the conduct of a costly sales department; and that after paying all the costs of doing all these things over a period of a year or more, he can get back in the price of the coats he sells enough money to reimburse himself for all his various costs and leave him a more or less ample profit besides. Whether he contemplates supplying the community with fur coats, or bread, or steel rails, or locomotives, or grand opera, or anything else demanded by the civilization in which he lives that requires organized effort to meet the demand, his motive is usually to enter a line in which he expects to be especially able to serve well and therefore to reap

the largest possible return in the form of profit. Firm in his belief, he enters business and works for his profit. If this were a philosophical work, we would trace out the influence of this man and his acts upon the general welfare of the whole community and upon his own personal development; but we purposely limit ourselves to technical matters of accounting, and assume that the normal manager of a business is in business to make a profit and that he measures the degree of his success by the size of his profit.

Obviously, profit is the money difference between the total price taken in from customers and the total costs paid out. We shall not undertake to discuss the various influences that will determine prices from the point of view of such a business man, for we are concerned with his costs. One thing only we must say — the business man must know what his costs are before he can set and ask his prices; and if for a period he is unaware of his costs, he is in danger of sustaining losses through fixing or accepting prices that barely cover, or even fall below, his costs. It is clear that a manager who conducts his affairs so that his costs are low is able to survive long in competition when selling his product on the market, and if his costs are lower than those of all his competitors selling the same or similar goods, he will get the largest surplus or profit.

2. **The Elimination of Waste.**— Practical management in the direction of reducing costs seeks to eliminate all waste in materials and effort, to conserve all materials and brain and brawn by using each in the most productive way and by combining all in such relationships that they render the greatest possible help in bringing the product into existence. If a workman loafs, there is waste, because his wage is a cost for which the business does not get the greatest return. If a process using material has an unnecessarily large percentage of scrap, there is a waste of material which costs money. If scrap is discarded when it could be sold or worked up into a profitable by-product, there is waste. If a house refrains from hiring a department superintendent at $5,000 a year and the workmen are less efficient for want of proper supervision, guidance, and stimulation to the extent of more than $5,000, there is waste in the management of the business. On the other hand, if a superintendent costs $5,000 and the business could drop him without a $5,000 diminution of efficiency, he is a wasteful item of cost.

3. **Concealed Losses.**— All this is very obvious, and no manager would dispute any one of these statements. But any manager might say: "How do I know there is more than normal loafing or less than reasonable efficiency on the part of a worker or superintendent? How do I know there is unwise purchasing, use, or waste of material? My whole enterprise is big, it employs three thousand people, and a mistake or a leak will not be revealed for months. I cannot keep myself informed of all that goes on and get my information quickly enough to act on it effectually." Just so. *The cost system is a device to keep the manager informed as well as possible of certain important things which would escape his attention without it.* As the cost system is improved and perfected, the information available becomes clearer, more refined, and more ready. In short, the directive intelligence is assisted by a cost system to become more sensitive to every element in the life of a going concern that affects its effectiveness.

When a business is very small, one man can carry all its details "under his hat," without the aid even of ordinary books. But even a small trader finds that he must keep books, and if his business becomes divided into two or more departments, he must devise some way of discovering the profits due to each separate department. Furthermore, if the conduct of a given department is fairly complex, it is sure to have its own more or less obscure cost intricacies, which should be fully searched out and clearly revealed by a cost system.

4. **Why Install a Cost System.**— *A. To Segregate Departmental Profits.*— At one time the proprietor of a very large collar and cuff and shirt factory in Troy attended personally to all the details pertaining to the financial end of the business. His plan was to deposit the receipts from the sale of collars and cuffs in one bank and the receipts from the sale of shirts in another bank. The factory was organized into two departments, and all of the checks used to pay for goods and to meet payrolls chargeable to the collar and cuff department were drawn on the first bank. Bills and payrolls for the shirt department were met by checks drawn on the second bank. The respective bank balances indicated only in a general way the profitableness of the two departments. But the business expanded; the two original departments were subdivided, new departments were added, and all were interrelated in that they drew

in varying degrees upon the time of the general office and upon the power plant, the light service, and other necessary and costly factors of production. This natural but complicated interrelation tended to conceal important matters of profit and loss. When the situation was realized, a cost system was installed, and the executive was not only relieved from the details of managerial observation and of finance, but was placed in possession of more trustworthy information concerning his enterprise than he could possibly have had without a cost system.

5. *B. To Indicate Lines to Push.*— One of the large leaks, especially in a manufacturing business, is caused by continuing unprofitable lines. Without a cost system it is difficult to know the relative profitableness of various lines, or even to discover a positive loss on a particular line. Many establishments pursue unwise manufacturing and selling policies because of the lack of cost information.

Recently a manufacturer of gift-shop novelties asked a cost expert whether he should push pillows or baskets. Both were selling well, and the factory was working overtime three nights a week. Apparently the business could do no better than to stick to its existing policy. Nevertheless, the installation of an appropriate cost system revealed the fact that more could be made by discontinuing the basket line and concentrating all productive energy on the pillows. A man is in business, not only to make a profit, but to make the greatest profit possible in an honorable way. Not only must he drop unprofitable lines, but he may well consider curtailing or even discontinuing other lines in proportion to the narrowness of their several margins of profit.

6. *C. To Determine When to Buy Rather Than to Make an Article or Part.*— Just as manufacturers often wisely decide to drop one line and concentrate on another, so they may decide that it is cheaper for them to discontinue some process or the manufacture of some part and buy the service or article from some one else. To determine this policy at all nicely, the manufacturer must have a fairly sensitive cost system so that he can accurately compare the cost to him of the process or part in question with the price some one else would charge him for it. One of the most successful manufacturers of women's coats and suits in New York City confines his own operations to the designing of the garments and the cutting of the cloth to his own

patterns, while he contracts with outside firms to perform all the other operations necessary to produce his commodities. His cost system reveals the fact that, considering the whole volume of his business and the rapidity of its turnover, he makes a larger percentage of profit by confining his direct efforts to operations in which he is especially efficient and by farming out other operations to those who can perform them as well as and more cheaply than he can himself.

A prominent book- and job-printing establishment in New York City found that machine typesetting could be sent outside and obtained more cheaply than in their own plant, despite the fact that the other firm paid higher rates of wage to the machine typesetters.

7. *D. To Determine Rates in Different Services Physically Combined in an Article or Organization.*— The publisher of a newspaper could not understand why he did not make money when his circulation was large and his production plant efficient. The proprietor of a New York daily gave him an elementary lesson in costs, and he discovered that newspaper advertising that cost him 24 cents a line to produce was being sold for 18 cents. Obviously, the more business done here, the greater the cut into the profits on papers sold. A cost system was established and a scientific advertising rate was fixed. Since then the enterprise has shown an average annual profit of over $100,000. A newspaper sells two things, news or literature to its readers and advertising space to its advertisers. The cost of news in excess of the revenue from the sale of papers must be borne by the advertisers using newspaper service.

Somewhat similar is the relation of different service departments in a single establishment. A newspaper that runs a job-printing department should have a cost system that will reveal costs in both the newspaper and the job departments so that one will not be run unwittingly at the expense of the other. Hotels with their room-renting, restaurant, banquet-hall, and ballroom services must also keep costs so accurately that one department or service which is unprofitable will not, under cover of general profits, absorb some of the profits of other departments. Rates for each service should be so fixed as to cover all fairly apportioned costs and give a profit as well. To be sure, in some cases an unprofitable service is continued as a leader or to attract business in more profitable directions; but this is

the result of a conscious advertising policy and is not due to ignorance of costs and of proper rates.

8. *E. To Segregate Departments in Which the Basis of Overhead Apportionment is Different.*— Many manufacturers use a general overhead burden rate on both the manufacturing and the selling ends of the business. This is bad policy because it makes impossible a comparison between the inside cost to manufacture and the outside quotation on the manufactured article. The student will understand this fully when he has learned how the expense of the manufacturing end of the business is absorbed by the material during its progress through the various factory operations, while the selling expense is a charge to the Profit and Loss account for the period.

9. *F. To Detect Details of Loss.*— All the illustrations given thus far tend to show the use of a cost system in keeping the management informed concerning the relative return from departments or services as wholes, so that each may be wisely dealt with as a unit. But a good system also acts as a detector of waste within a department or even a process, and often points out ways for improvement and increased gain.

A cost system certainly gives detailed information concerning each hour's work of men, the proportion of used material to scraps and cuttings, and a thousand other items, each of which sets the manager to making comparisons and devising forms of economy. Not infrequently a manager without a good cost system overlooks an item of cost due to invisible waste, as in a textile mill, or breakage due to handling fragile products. A cost system will take account not only of these physical wastes or shrinkages, but also of value diminutions. For instance, in the cloak and suit industry, where styles become obsolete quickly, it is the custom to " mark down " the garments at the end of the season. The loss due to " mark-downs " as well as to physical waste must be anticipated when calculating costs and fixing selling prices at the beginning of the season.

10. *G. To Check the Inventory.*— Diamond merchants for the most part keep stock records as a means of controlling the inventory and preventing theft. Manufacturers of ostrich feathers and silk fabrics using material costing respectively, $100 and $10 a pound, also need stock records. A complete cost system furnishes a means of checking the accuracy of the inventory figures.

A large manufacturer of art wares asked a cost accountant how it was that with larger sales and with prices figured so as to allow a fair profit, he did not see the profit anywhere around. The accountant answered that the profits were tied up in the inventory. However, a manufacturer can never be sure that the taking of an inventory will reveal the profits unless a cost system is introduced to keep a check on the inventory.

11. *H. To Apportion Supervision.*— The expense of supervision is one of the most, if not the most, illusive element of cost. Whenever special jobs are undertaken, it is obvious that more supervision is required than on the regular standardized product. When a cost accountant is asked, for example, how much of the factory superintendent's salary is applicable to special manufacturing departments, the accountant cannot, of course, answer directly, but he must find a satisfactory basis for making the apportionment of the superintendent's time so that one department will not be unduly penalized and another subsidized. Unless each department can be properly charged for the expense of supervision, it is likely that some products will be figured too low, and the loss on these products will be concealed because the concern as a whole is making a profit.

A customer once asked a manufacturer of sheet-metal products to figure on an especially intricate job. If figured on the basis of the customary rate for overhead expense, it was evident that the firm would lose money on the job; consequently, the cost accountant suggested that a special rate be used that would be sufficient to cover the added amount of supervision deemed necessary. This was done and a quotation made which the customer accepted.

12. *I. To Check Estimates.*— In a great many lines of business it is necessary to make an estimate of the cost of manufacture in order to fix a selling price before actual manufacturing operations begin. When this is the case, a cost system is needed for the purpose of furnishing a check on the accuracy of the estimates. Unless actual costs are compared with estimated costs, it is not unlikely that unexpected increases in the cost of production will escape the proprietor's notice. A shoe manufacturer in Brockton once decided that he would use calf skins costing 30 cents a square foot for the uppers in a certain line of shoes. The foreman of the cutting room, who acted also in the capacity of purchasing agent for upper leather, bought a superior

quality, paying 35 cents a square foot for it. At the end of the season the books were closed and a loss of $10,000 was disclosed. On investigation the loss was found to be in the excessive price paid for upper leather. Had the manufacturer had a proper cost system in operation, the loss would have been detected as soon as the first lot of upper leather was cut, and steps would have been taken to prevent the recurrence of the error. Subsequently a cost system was established as an insurance against such leaks.

13. *J. Teamwork among Manufacturers.*— The worst competition against which manufacturers have to contend is that of competitors who do not know their own costs. When a manufacturer bids against a competitor who is ignorant of his costs, it is possible that the competitor may get the contract and lose money without knowing it at the time. This educates the public to underestimate what would be a reasonable price for the commodity. The present trend of activity of manufacturers' associations is to suppress ignorant competition by a campaign of cost education among association members. Energetic business men do not object to intelligent competition on the basis of efficiency, but they dislike to compete against one so ignorant of the condition of his own affairs that he excludes a rival in the act of ruining himself. The secretary of one large association reports that after literature had been distributed to members showing the elements to be included in cost calculations, the number of failures dropped from fifteen to seven per cent a year.

One could go on piling up illustrations that indicate the need for cost systems. Those given above, taken from a variety of sources, reveal some of the reasons why cost systems are adopted, and make clear the motives that actuate manufacturers in installing up-to-date cost systems.

14. **Definition of a Cost System.**— Thus far we can derive a tentative definition of a cost system. *It is an adjunct to the records of a business, devised to enable the administration to be kept constantly aware of the outlay necessary to enable the concern to perform a given service, complete a process, or fully produce a commodity.* It is the most important of the various devices that aid the enterpriser to combine the various factors of production in the most advantageous proportions and relationships and to adjust his output to the market so that there will accrue to his business a maximum net return.

Questions on Chapter I

1. What is the motive for business enterprise?
2. In what way is a cost system an aid in the management of a business?
3. What are some of the reasons usually given for installing a cost system?
4. In what way does a cost system bring to light leaks in a business enterprise?
5. How does a cost system furnish a check on the inventory?
6. Name an element of cost which is frequently underestimated.
7. What attitude do manufacturers' associations usually take toward cost systems?
8. Suggest a method for controlling waste in a wooden-box factory so as to provide a check on the sawdust waste.
9. What benefits have you observed from a cost system with which you are familiar or which you have read about?
10. Suggest a plan for controlling lost time in a shipbuilding plant.
11. What plan can you suggest for preventing waste of veneer in a piano-building plant?
12. Where would leaks be likely to occur in a newspaper publishing plant selling circulation and advertising? There are a city edition with five pages of news and seven pages of advertising; a country edition with five pages of news and one page of advertising; and a Sunday edition with five pages of news, a comic page, a women's page, and nine pages of advertising. Papers sell for $2.10 per 100 to agents and dealers, and advertising sells for $0.22 per line.

CHAPTER II

RELATION OF PROFITS TO COST

15. **An Illustrative Case.**— In the first chapter it was stated that the prime object of business enterprise is to secure profits, that is, to get for the product a total money price greater than the money cost to run the business and deliver its commodities or services. Exhibit A shows the relation of profits to cost, on the one hand, and selling price, on the other.

RELATION OF PROFITS TO COSTS

I. Total selling price of the whole product of a business for a given period is gross income of the business:

II. Total outlay of the enterprise to produce and deliver the goods to the purchaser is total cost:

III. The difference between I. and II. is the net profit.

IV. Net profit can be increased because of:
  A. Increased gross income;
  B. Decreased total cost.

V. To increase gross income or insure greater price in the market is a problem of advertising and selling.

VI. To decrease costs is a problem of management and production.

EXHIBIT A.

Clearly, profits can be made greater either by getting higher prices for goods and services or by reducing the cost of producing them. We are concerned with the *methods of recording costs accurately,* so that no item will be overlooked and so that the manager may take effective measures to keep down costs. It is necessary for us to define "total cost" and then to enumerate all the elements of cost that enter into the total. Let us construct an imaginary case as an

introduction to the more difficult ones of actual business life. A man has $100,000 with which to set up in business to produce a mechanical toy for the market. On January 1 he rents quarters with light, heat, and power for $5,000. He buys lathes and other machinery, dies, and tools for $15,000. His materials in the form of metals, paint, varnish, etc., come to $10,000. His labor cost, including his own reasonable salary of management, comes to $65,000, and miscellaneous expenses take up the remaining $5,000. His plant makes the various parts, assembles them, paints them, packs them, and accomplishes all in just one year; and on the last day his materials, panels, nails, boxes, etc., are just used up, his small tools are all just worn out, and he finds a purchaser, not only for his entire output of toys, but also for his partly worn-out heavy machinery. He receives $125,000 for his toys as a single lot and $4,500 for his partially worn machinery, a total of $129,500. This gives a profit of $29,500; or, if he wishes to assume that he should get from the enterprise interest at 6 per cent before he could regard himself as making a clear profit, then we can say that on his $100,000, as a capitalist, he gets $6,000 interest, and, as an enterpriser, he obtained a profit of $23,500.

16. **Inventory Adjustments.**— But most business concerns cannot open at the beginning of the year and close neatly at the end. They find at the end of a calendar year, or some other selected financial period, that they have (1) raw material on hand; (2) work in process at various stages; (3) equipment in various stages of wear or depreciation; and (4) finished but unsold stock on shelves. All these things represent valuable property which must be accounted for. At the outset a certain sum of money is *invested* by an enterpriser and used to purchase equipment, supplies, material, labor, services of lands, buildings, and other things necessary to conduct the business; at the end of some financial period the original investment has been drawn upon and depleted. Such outgo is *cost.* The total money outlay is not the cost, but only that portion of the outlay which is not offset by something of value remaining on hand. Consequently, at the end of each financial period a firm *takes stock,* to discover the total value of things on hand to offset a part of the money outlay, so that the remaining total cost for the period may be known.

Stock-taking is a general operation including the taking of a num-

ber of *inventories.* An inventory is a list of a class of things showing the quantity of each item on the list and the value or the cost of each item and of the list as a whole. First there is the inventory of finished but unsold goods on the shelf; then there is the inventory of work in process; third, an inventory of raw materials and supplies; and finally an inventory of plant or an appraisal to determine the depreciated value of the permanent plant with all its equipment. Each inventory presents its own problems and has corresponding principles and practices.

17. **Inventory of Goods on Hand.**— For the wholesale or retail merchant who does no manufacturing, stock-taking is a fairly simple matter, for it consists of little besides the inventory of unsold goods or stock on the shelves. But manufacturers also take an inventory of finished goods ready for sale. The units are listed and the cost set after each unit. This second step, the costing, is usually performed by the manufacturer himself or a purchasing agent, when the goods were bought and not made by the house itself. The cost put down is the actual money cost as shown on the vendor's invoice. Business men sometimes inventory their finished goods, not at *cost,* but at the *market value at the time of the inventory* if the price of such goods has dropped. This is done in order to make the stock inventory appear low and the money outlay correspondingly high, and thus conceal some of the profits on goods that were actually sold during the period. Good theory and honest practice require that a fall in value while goods are on hand should be regarded as a loss, just as a rise in value should be regarded as a profit due to the judgment or fortune of the management. Such profits and losses reveal themselves only when the goods are actually sold. When the Government taxes a business concern on the value of its property or on its profits, it often recognizes the fact that materials or goods on hand have fallen in value since the time when they were bought by the concern. The Government allows the concern reasonable discretion in setting an inventory value below actual cost, even though such loss of value can be proved only by actual sales. A manufacturer must list his finished goods in his inventory on a cost-to-produce basis, and not on the basis of prospective selling price or even current market value. Obviously, raw material and supplies are also inventoried on the basis of actual cost. The formula in all these cases is:

(1) Cost of stock on hand at the beginning of the period
plus
(2) Cost of stock purchased during the period
minus
(3) Cost of stock on hand at the end of the period
equals
(4) Cost of stock used up or disposed of during the period.

Work in process must also be inventoried according to the unit cost of the material when purchased plus the labor and other service costs incurred in bringing it to the stage of completion in which it is at the time of the inventory. The same is true of finished parts that are to be assembled in a final product.

Not only the theoretical principles on which the calculation of these inventories is based, but also certain practical and proximate devices used in business for the ready estimation of cost of items entering into the inventory, will be considered more fully later. Just now we wish to emphasize the necessity of taking stock by means of the compilation of various inventories for all going concerns desiring to avail themselves of accurate cost information in fixing their prices and in ordering their production and sales policies.

18. **Plant Appraisal: Depreciated Value; Depreciation.**— In calculating cost items due to the depletion of the plant and its equipment for the period, the formula is similar to that for goods, supplies, and materials, namely:

(1) Cost of plant at outset (or value at the beginning of the period if it is other than the first)
plus
(2) Cost of additions during the period
minus
(3) Present or depreciated value of the plant at the end of period
equals
(4) Cost of portion of the plant used up during the period.

The great problem is to determine item three (3) above, the present value of the partially used-up plant. A thousand-dollar machine may last for ten years, wearing out at an even rate so that one could say that it depreciated at the rate of $100 a year, and had, therefore, at the end of each successive year a depreciated value of $900, $800, $700, $600, etc. The depreciation in each year, chargeable as a cost to that year, would be $100. Another machine might run an uneven

course. The exact rate of depreciation for the whole or any part of a plant is a technical matter that must be settled in accordance with mechanical and engineering as well as accounting principles.

A physical examination of a plant by engineering experts to determine just how far each unit in the plant is worn out and what its prospective life may be, and consequently to establish just what portion of its initial cost is to be regarded as a present asset, is called an *appraisal*. It is analogous to the actual counting of finished goods to check up the stock records on the books of the concern. Although all firms every year check their *book inventories* of goods by *physical inventories*, yet very few have physical or technical appraisals of their plants except at long intervals or at times when changes in organization or proprietorship are contemplated. Usually an arbitrary *rate of depreciation* is customary in a given field of business, and if the rate is, say, 15 per cent, then the depreciated value, or item three (3) in the formula, becomes always 85 per cent of items one (1) and two (2) together. In some cases it may be desirable to have various arbitrary rates for particular machines, pieces of equipment, or buildings, and, when they were acquired in the middle of the year, to check off as depreciation only a fraction of the depreciation allowance commensurate with the fraction of the year during which such items were in service.

19. **Total Cost.**— We have indicated that *the total cost is the total outlay minus the cost of valuable things left on hand.* We are now interested in distributing that cost among the finished articles produced and sold, so as to compare the cost of each with its particular selling price. This necessitates an explanation of what constitutes *finished* goods, and what steps or processes must be taken to finish them. Obviously, the finished product of a lumber camp is the raw material of the saw mill, and the finished product of the saw mill is the raw material of the furniture factory, while the tables, chairs, beds and other finished products of a furniture factory are the stock handled by the big merchant who adds time and place service and sells to ultimate consumers.

20. **Cost to Make and Selling Expenses.**— For practical purposes two great divisions of cost are established, (1) *cost to make* or produce goods that are worked on by the plant, and (2) *expenses of selling* the product to the next manufacturer, merchant, or consumer

who is in the market to buy. Merchants have *selling expenses* only, but manufacturers have both *cost to make* and *selling expense.* The proportion of *total cost* attributable to selling varies greatly according to the nature of the business. Strictly speaking, no commodity is fully produced until all operations, including fabrication, handling, selling, delivery, etc., have been performed so as to place it ready for use by the ultimate user. But each particular business house concerns itself only with the costs of its own contribution. The furniture factory counts its cut lumber purchased from the saw mill as *a material cost,* adds its *labor cost,* its office and other overhead *expenses* and also the expense of selling the furniture to the merchant, and thus calculates its cost for each article it turns out.

21. **Relation of Profits to Costs.**— From the foregoing one will see that there is a very close relation between profits and costs. Merchants and manufacturers are all desirous of keeping costs down in order that their businesses may show a wide margin of profit. The relation of profit to costs has been brought out in Exhibit A above. The profits can be made larger, on the one hand, by increasing the selling prices without increasing the cost, or, on the other hand, by decreasing the cost without decreasing the selling prices. A cost system shows a manufacturer where leaks in the cost of production occur, so that steps can be taken to reduce the loss caused by them, and also aids in furnishing a basis for fixing intelligently the selling prices on the various lines sold. The success of the steel industry has often been attributed in part to the fact that steel mills usually have a very highly developed cost system, which shows the exact cost of each ton of pig iron, steel ingots, rails, or structural shapes manufactured. Correct cost data are a necessary aid to the busy executive in administering any large business.

22. **Process and Job-Order Plants.**— For cost purposes it is the usual practice to divide industrial enterprises into two classes, known as "continuous-process plants" and "job-order factories." In process plants the product flows through, as it were, from the raw-material end to the finished-stock room in a continuous stream. Usually a single, standard article is produced, and the same operations are performed on one unit of the product as on another. A cotton-mercerizing plant is an example. The yarn or other material to be processed is put into caustic-soda solutions of various strengths, where

it remains a certain length of time, after which the stock is removed. Each pound goes through the same process, and the cost calculation consists merely of dividing the pounds mercerized into the sum of the labor and expense for the period. The owner of such a plant could not afford to charge his customers prices insufficient to cover all costs plus a fair margin of profit. The packing of dates in one-pound cartons is a continuous process. The cost of a one-pound carton is found by dividing the sum of the cost of dates and cartons used and the labor and expense for the period by the number of pounds packed. It is thus seen that cost accounting in continuous-process plants does not offer great difficulties.

But the other kind of factory, known as the "job-order factory," does not turn out a continuous stream of standard products; it makes articles varying in kind, number, style, and quality according to orders received from customers. For example, a straw-hat factory is of necessity a job-order plant. A single customer may order two dozen hats with a certain style of plait, width of brim, and height of crown, and in a range of seven different sizes. He may also include in his order an item of two dozen hats of a different style and color, and may also require that his goods be marked with different distinguishing labels. Obviously, each such order contains the makings of a number of cost-accounting problems. It would not do to follow the plan of the process factory and divide the total outlay by the number of hats produced in order to ascertain the cost of each hat. To be sure, each hat has in its cost the elements of material, labor, and overhead, but it is probable that no two hats of different styles have these elements in the same proportions or the same amounts. Hence, just as the management about to fill a customer's order must give the factory detailed information concerning the material, size, and style of each hat, so also must the accountants keep a parallel set of detailed cost records. The routine of cost finding in job-order factories is, therefore, much more complex than in process factories, although the elements entering into the cost of a unit of the product are the same. The cost of a carton of dates or of a motor truck is made up of material, labor, and expense in either case, but the methods of making the calculations are of necessity different.

23. **Summary.**— A close relation exists between profits and costs in any business undertaking. Closing the books by means of inventories furnishes a basis for arriving at the cost of business done during the period with the resulting profit or loss on transactions. A merchant can ascertain the cost of an article by consulting the vendor's invoice or by obtaining a market quotation. But a manufacturer must calculate the material used and the labor and expense expended in converting the material into the finished product in order to arrive at the cost of merchandise. The manufacturer's problem is the more difficult of the two, and so cost records must be introduced to enable him to ascertain the cost of production accurately. The cost of a unit of the product made in a continuous-process plant is easier to calculate than the cost of an article made in a job-order factory. After the cost of finished merchandise has been obtained, its expense of selling remains to be considered. This is applied to the cost of doing business during each period before the net profit on operations is arrived at.

Questions on Chapter II

1. What is the relation of profits to cost?
2. What adjustment is made when an inventory of material remains on hand at the end of a period?
3. How is stock valued at inventory time for the purpose of closing the books of a business enterprise?
4. Define total cost. Illustrate.
5. Differentiate between cost to make and selling expense.
6. Make a chart showing the relation of profits to costs.
7. Explain what is meant by a (*a*) process plant and a (*b*) job-order factory. Give an illustration of each.
8. Why is it easier to fix a safe selling price for an article produced continuously and in great numbers than for an article produced to meet special-order specifications?
9. If lumber costs $65 per 1,000 board feet, and the labor and expense required to convert lumber into boxes is figured at $75 per 1,000 board feet, what is the profit on an order for 5,000 boxes, the inside dimensions of which are 2′x2′x4′, made from one-inch thick boards, the selling price being $6 per box?

CHAPTER III

ELEMENTS OF COST

24. Main Elements and Their Subdivisions.— In the last chapter it was indicated that *total cost* for any unit of goods is made up of the *cost to make* it and the *expense of selling* it; a merchant has no cost to make as does a manufacturer, but he has a corresponding outlay, namely, the price he pays the manufacturer for each unit of goods. But the two major divisions of cost are themselves subject to subdivision. Each is made up of many items, and if all the items are not included, the calculation of either will be defective. Considering first *cost to make,* let us see what the *elements of cost are.*

25. Raw Materials.— Taking a furniture factory as a typical production plant, we readily see that in trying to calculate the cost of making a desk, the proprietor must immediately make a subdivision of his outlays. Obviously he has to pay for materials that went directly into the desk and for labor time spent directly on the desk. But he has other costs that are in some proportion chargeable to that desk, as to all other pieces of furniture made in his plant, for instance, some proportion of the salaries of his superintendents, designers, engineers, and janitors. Just now we shall confine our attention to outlays of material and effort directly and exclusively made in connection with a given article (as the desk), job, or process. All such direct outlays expended in terms of money constitute *prime cost,* in contradistinction to *secondary* or *indirect* outlays that are spread over many articles, jobs, or processes of the plant according to principles which will be explained later. *Prime cost is the total expenditure for material and labor of any sort that can be assigned in a definite amount to a particular article, job, or process because such material and labor were directly used on that article, job, or process.*

The first element of the prime cost is the outlay for raw materials, and this is the easiest item of cost to calculate. By raw materials we mean the materials entering into manufacture that a given plant

obtains before it begins its own operations. It has been stated already that the raw material of a furniture factory is the finished product of the saw mill. *Raw material includes all material that enters directly into the product;* and though its form may be changed by the processes through which it goes during manufacture, it can usually be observed in the finished article. The quantity of raw material may be ascertained by measuring or weighing the finished article and making allowance for waste, or it can be ascertained by the record of material actually issued from storerooms. Of course, the cost of materials is obtainable from the vendors' invoices or some record on which the prices paid were entered.

26. Direct Labor.— In every industrial undertaking it will be found that, on the one hand, some of the employees are engaged directly in processing the product through the various operations, while on the other hand, other employees are occupied in supervision, clerical work, inspecting, and tending the power plant. The former class of employees is usually referred to as *direct labor,* and the latter class as *indirect labor.* Sometimes the less desirable terms *productive* and *non-productive labor* are used instead of those given above. When an operative is working on the product, his time can be assessed *directly* against a given process or job by simply recording when he began working on the process or job and when he stopped. This is the reason why his is called direct or productive labor. In order to convert raw material into a finished product certain operations are necessary. The length of time spent by operatives on each process or job has to be ascertained from an analysis of the payroll and such records of time as may be kept for the purpose of obtaining the direct-labor cost. For example, in a shoe factory it may take one hour of an experienced workman's time to attach the sole leather to the uppers of the shoes in a case containing 36 pairs. The direct-labor cost of this operation for one pair of shoes is easily calculated as one-thirty-sixth of the hourly wage for the operation. The sum of raw-material cost and direct-labor cost is the prime cost.

27. Factory Overhead.— The time of employees spent in general activities, such as office work, stores distribution, and keeping time records, as well as the time of those who supervise the plant, make up plans, and promote the general welfare of the business, cannot be directly associated with any single unit of the product. The outlay

for such general services is referred to as an *overhead burden* on the business as a whole. Of course, the cost accountant uses all his ingenuity to distribute this burden equitably among the several products. In order to ascertain what labor is direct and what labor is indirect in a given concern, an accountant usually finds it necessary to analyze the payroll. It will be found that in nearly every department of a factory there is indirect labor; at least, there is a foreman and his assistant. Then there is usually a power plant with an engineer and fireman. Millwrights, carpenters, and general-utility hands are also indirect labor. All employees in the factory office are indirect labor.

The cost of services such as light, telephone, and drinking-water service is chargeable to overhead expense. So also are expenditures for minor repairs and those constantly recurring items connected with the general business usually paid out through the petty-cash fund.

Supplies issued to departments are a charge to the overhead expense of the respective departments. When oil for machinery is kept in the oil room and given out on requisitions, it is a part of the expense of running the lathe, milling, punch-press, screw-machine, drilling, or other departments.

When the shop is given an order to replace defective work on articles that have been rejected by inspectors, the cost of such extra work is chargeable to the overhead expense of the department in which the fault occurred. If the truck used for hauling raw materials needs a new bearing and is sent to the machine shop to have repair work done, the cost of the job is charged to overhead expense.

In every plant it is necessary to make an estimate of the amount of fixed charges that are assignable to each period. Under this head come insurance, taxes, and depreciation. The practice is to prorate the annual cost over the accounting periods. In a plant in which the books are closed monthly each period should bear one-twelfth of the annual cost of fixed charges. The sum of the prime cost and overhead expense gives the cost of manufacture, as shown by Exhibit B. In figuring the cost of manufacture, the overhead expense incurred in connection with handling stores is sometimes applied as a burden on raw material used, leaving the balance to be applied as a burden on direct labor.

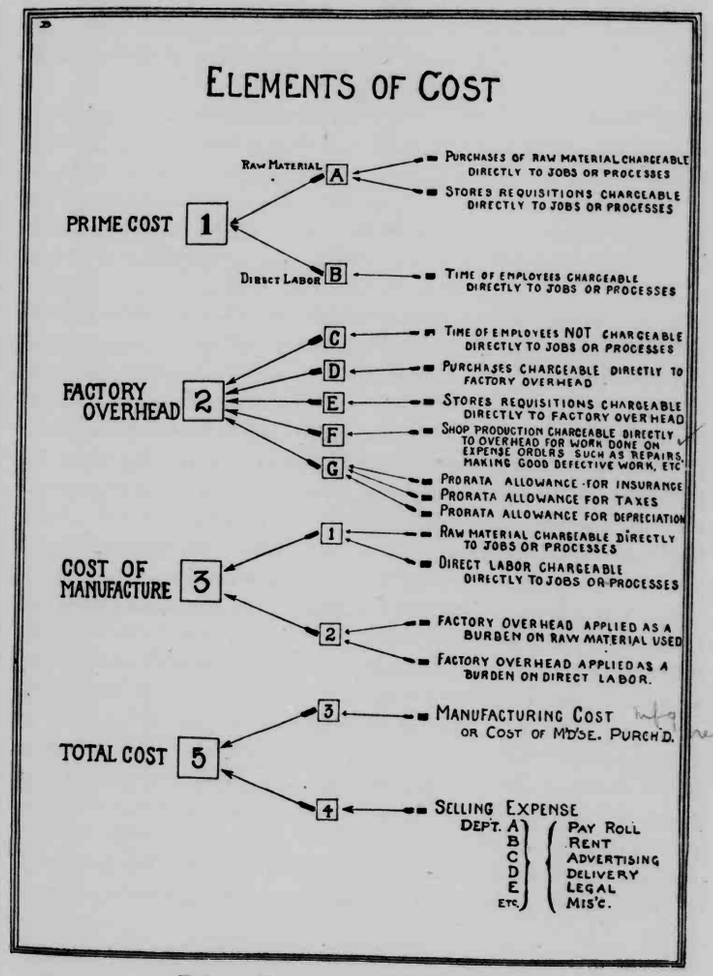


EXHIBIT B. GENERAL COST FORMULA

In general, we can define *overhead expense for a given period as the sum of all outlays of money for goods and services necessary to the general conduct of the business during that period and either impossible or very difficult of assignment as directly related to any given unit of product or process.*

28. Selling Expense.— The selling expense that a manufacturer adds to his *cost to make* in order to arrive at his *total cost* is often regarded as a whole and not subdivided minutely. It includes all salaries paid salesmen, cost of samples, expenses of maintaining show rooms, traveling expenses, advertising, etc. In great mercantile concerns and manufacturing concerns with national distribution of their own wares, the physical plant and personal staff devoted to selling is so great that subdivisions similar to those in the *cost-to-make* formula must be made. The direct-labor cost of the salesmen on a given line can be distinguished from the overhead or indirect-labor cost of maintaining the salesmanagers. In department stores showcases and mechanical devices used in selling are comparable with lathes and drills in a machine shop producing manufactured articles. In short, the principles of direct charging to a given operation in selling and of carrying the cost of general activities as a burden on all sales is applicable when the scope and diversity of the business make knowledge on these points necessary to intelligent administration.

29. Variations in the Cost Formula.— In any particular industry there is more or less variation in the items to be included in the different elements of cost. Examples of cost items that are peculiar to certain enterprises are royalties paid for the use of machinery, sacks in cement mills, special dies and tools in jewelry and novelty manufacturing establishments. Sometimes it is the practice to manufacture parts of the product first and then assemble them into the completed article. If this is the case, it is best to separate the departments in which parts are made from those in which the finished product is assembled. One can perceive readily that the product of the parts departments is the raw material of the assembling departments.

At the present time an effort is being made by a number of manufacturers' associations to define and determine the items that properly enter into the cost elements of a unit of the product, as a preliminary to devising uniform cost systems for various industries.

30. Specific Applications of the General Cost Formula.— There are, of course, certain modifications that have to be made in the general cost formula in order that it may be serviceable to a particular industry or a special concern in the industry. To show some of the variations in the cost formula, reference will be made to several Government publications which deal with the cost of producing and manufacturing in several of our largest industries.

31. Cost Determinations by the United States Government.— The general cost formula shown in Exhibit B is in harmony with the various particular formulae established by the United States Government for use in industries that the Government has investigated for the purpose of determining tariff rates. These Government investigations have been carried on with great thoroughness by large staffs of qualified experts. The following particular cost formulae for the steel, clothing, and cotton industries will serve to indicate the modifications of the general formula that have been made for application to specific cases.

32. Cost Formula for Bessemer-Steel Rails.— The Commissioner of Corporations' "Report on the Steel Industry," Part 3, deals with cost of production. The cost formula for heavy Bessemer-steel rails is given as follows:

A. Material:
  Ingots less scrap
B. Labor
C. General Expense of Works:
  1. Fuel
  2. Steam
  3. Rolls
  4. Material in repairs and maintenance
  5. Supplies and tools
  6. Miscellaneous and general works expense
D. Mill Cost = A + B + C
E. Additional Cost:
  1. General and miscellaneous
  2. Depreciation
F. Total Cost = D + E

In the "Report on the Steel Industry" the term "prime cost" was made to include direct labor and materials used. It also included labor and materials used in making departmental repairs. This was logical and proper for this particular industry because, for

example, the relining of a blast furnace (the large chamber in which combustion takes place) costs a great deal, must be done regularly, and can be directly assessed against the particular process of reducing ore to pig iron. In a sense, the cost of lining is analogous to the cost of the coke, limestone, and the ore itself that are put into the blast furnace and used up.

The items of general and miscellaneous expense in the general formula, Exhibit B, are parts of the general overhead (2 C, D, E, F, G), but in this particular case there was a logical reason for isolating them. They were expenses arising in the administration office away from the works, and these were charged at an arbitrary rate against each ton of the product. The item of depreciation included the diminution of the value of the mine as a source of ore due to depletion as well as the depreciation of the operating plant, and the total charge was distributed at an arbitrary rate as a burden on each ton of the product.

33. Cost Formula for Clothing.— The elements of cost for clothing such as a three-piece suit have been stated by the Tariff Board as follows:

A. Cost of Stock:
  1. Cost of cloth
  2. Cost of trimmings
  3. Credit waste
  4. Stock cost = 1 + 2 − 3
  5. Freight in
  6. Total cost = 4 + 5

B. Productive Labor

C. Factory Expense:
  Distributed to each garment on the basis of productive labor in each garment

D. Total Factory Cost = A + B + C

E. Selling and General Expense: (admin ?)
  Distributed to each garment on basis of ratio of total selling expense to total value of output

F. Final Cost = D + E

In the report by the Tariff Board on Schedule 12, the term "cost of stock" was used to cover the items of material entering directly into the manufacture of the finished product. In arriving at the total cost of stock, two special circumstances were recognized. All the waste and clippings from the rolls of cloth were sold, and the

money derived from this sale was regarded as a salvage and set up as an offset to reduce the cost of cloth (see A 3 above). On the other hand, the incoming freight charge on the bundles of cloth purchased was regarded as an addition to the cost of the cloth (see A 5 above).

34. Cost Formula for a Weaving Mill.— Agents of the Tariff Board were supplied with forms on which the elements of cost were definitely stated in order to enable men in the field correctly to report the cost of manufacture. These forms were quite uniform, and reference to the one used for the cotton industry, entitled, "Cost of Manufacture in a Weaving Mill," shows the formula used in arriving at costs; it will be observed that this particular formula follows the lines of the general formula and is simply more minutely subdivided:

A. Materials Used

B. Productive Labor:
  Prime cost = A + B

C. Works Expense:
  1. Mill supplies (including belting, oil, brooms, picker sticks, lug straps, pickers, loom harness, burlap, rope, cases, etc.)
  2. Fuel
  3. Power purchased
  4. Repairs and maintenance
  5. Administration expense chargeable to manufacturing
  6. General labor — engineer, fireman, warehouseman, yard and watchman
  7. Miscellaneous operating expenses, such as office supplies, telegrams, and sundries
  8. Accident insurance
  9. Hauling and stable

D. Fixed Charges:
  1. Depreciation
    (*a*) Depreciation of buildings
    (*b*) Depreciation and obsoletion of machinery and equipment
  2. Fire insurance on mill buildings
  3. Taxes on mill property

E. Total Cost in Bulk at Mill = A + B + C + D

F. Less Waste Sold

G. Net Cost in Bulk at Mill = E − F

35. Engineering and Drafting Expense.— It often happens that in the mechanical industries, in addition to the operatives at the works, engineers and draftsmen are employed to prepare specifications and to make original drawings and tracings from which

blueprints can be had. The total cost of this office, its upkeep, materials, and salary charges, may be regarded as an additional expense to be added to the cost of manufacture.

We find other additional separate departments or sources of expense in particular industries, which are definitely recognized, but which are not logically parts of an item in the general formula. They should be added as a separate item of cost, as in the case of engineering and drafting expense.

36. Sources of Cost Data.— Generally speaking, all information concerning the cost of production is obtained from five kinds of original documents: (1) bills for goods and services purchased, (2) stores requisitions for goods taken out of the storeroom, used in conjunction with original bills, (3) payrolls for all salaries and wages, (4) shop production and cost reports, and (5) estimates of depreciation allowances. It is the business of the cost accountant to organize a routine by which each of these documentary sources of information will be examined and their items allocated to one of the subdivisions of the general cost formula. He also devises the forms of these original documents so that their inspection is simple and they have the amounts placed in columns or subdivisions which will indicate their final allocation to the various items on a cost-summary sheet for a particular job or process. This summary sheet will look something like the general cost formula, Exhibit B, or one of the type formulae for particular industries just given, but with amounts inserted and totals calculated.

Questions on Chapter III

1. Name the main elements of costs.
2. Define each of the elements going to make up the prime cost.
3. Name six items chargeable to overhead expense.
4. How is overhead expense usually applied to the product?
5. From what source does the information pertaining to overhead expense come?
6. What is meant by fixed charges? How are they handled?
7. Which element of cost do you think offers the least difficulty in making the cost calculation?
8. Under which element of cost would the following items in a furniture factory be classified: lumber, hardware, glue, varnisl., sandpaper, oil for machines?
9. How would you classify the following items in a phonograph-record plant: money paid artists to sing or play for recording, wax used for

discs, copper for matrices, clay and shellac for records, and labels for records?
10. What are the U. S. Government cost formulae for Bessemer-steel rails, clothing, and weaving-mill products?
11. Make a particular cost formula for some industrial plant with which you are familiar.
12. Examine a typewriter and prepare a chart showing in as much detail as you can the elements of cost.
13. Refer to some standard encyclopedia and read how cotton yarn is made and then prepare a chart showing in detail the elements of cost.
14. Read an article in the encyclopedia on how paper is made and prepare a chart showing the elements of cost.
15. Do the same for sugar, paint, soap, and gasoline.
16. Name ten elements of cost to be considered when estimating the cost of construction of a frame cottage.
17. A large Michigan furniture manufacturing company owns timber lands, saw mills, and a furniture factory. What elements of cost should be taken into account in figuring cost of (*a*) rough lumber, (*b*) dressed lumber, and (*c*) Martha Washington sewing tables, Hoosier kitchen cabinets, tables, chairs, etc.

Selling expenses apportioned by selling price & mfg. cost. Latter on basis that it is harder to sell a higher priced article

CHAPTER IV

PRODUCTION AND COSTS

37. Production Control.— In every industrial enterprise certain formalities are observed in exercising control over production. The routine connected with production is less complex in process factories than it is in job-order plants because a standard product is being manufactured continuously. The type of production system found in operation determines to a large extent what procedure must be followed in cost finding. In case the superintendent depends upon daily or weekly reports to guide him in exercising control over production, one knows that in all probability a process cost system is required. But, in case the superintendent issues a formal order for every job to be done, the accountant knows that a job-order cost system is probably needed to meet the conditions in the plant.

38. Continuous-Process Plants.— Extractive industries furnish many good examples of continuous-process plants. Take a marble quarry, for example, and note how the enterprise is organized for the purpose of extracting marble from the earth. The business of quarrying goes on day after day, the product always being blocks of marble, of varying size but measurable in tons. The quarry superintendent increases production when necessary by adding more workmen, and curtails production by laying off workmen when a depression in trade occurs. At stated intervals the superintendent renders reports to his superior officers covering all of the quarry operations. From this production report they can judge whether or not instructions should be issued to the superintendent to increase or decrease production. Furthermore, the information contained in the quarry production reports, together with the data in the books of the company, make possible the calculation of the cost per ton of marble produced during any given period. It will thus be seen that cost accounting is closely related to production reporting and plant administration. What has been said regarding a quarry applies with equal

force to other extractive enterprises, such as mines, clay pits, and gravel beds.

In order to illustrate how a manufacturing establishment may be operated as a continuous-process plant, reference may be made to the business of converting raw hides into sole leather by means of a tanning process. A sole-leather tannery is equipped to handle a certain number of hides daily. Let us say that each day 1,000 hides are put into the initial process, and an equal number removed from the finishing process. From the time a pack of hides is started to the time they are finished several months may elapse. During this time the hair and flesh are removed, and the tannin replaces the moisture and animal fats in the hides, converting them into sole leather. Evidently the process of tanning is continuous. The superintendent receives a daily report containing full details regarding production, number of hides put in process, number finished, tanning materials used, and so on. From these production reports and the information contained in the books of the company the cost per pound of the finished product can be determined readily. The cost per unit of product may be regarded as the same for all hides produced during the period. What has been said applies equally well to any plant in which only one standard product is being made.

There are, of course, many factories in which a variety of standard products are being manufactured. A good example of such a plant is a cotton-yarn spinning mill producing several sizes of yarn, some of which are single (one-strand) and some of which are ply yarns (two or three strands twisted together). The cost of production per pound is different for each size of yarn, and consequently the problem of controlling production and of figuring costs becomes a little more complicated than in the case of the quarry or the tannery. Nevertheless, in manufacturing the product only one kind of raw material is used, namely, cotton. The bales are opened and sent to the cardroom, where the cotton is first made into loose strands, called sliver, without twist, after which it is given a slight twist, when it is called roving. This roving, which is about the size of one's finger, is the raw material for the spinner. In the spinning room the roving is drawn out and spun into yarn. If two-ply yarn is wanted, it is necessary to twist two singles together; if three-ply, three singles; and so on. The manufacture of each size of roving and each size of

yarn may readily be recognized as being a different process to be kept track of separately and in which the cost of the product is to be separately figured. This is, in reality, just what has to be done. The overseers of the card and spinning rooms render daily reports showing the number of persons employed, machinery in operation, material consumed, waste produced, and quantity of product finished. These production reports, together with detailed statements of labor and expenses, enable the accountant to calculate the cost of production of each size of yarn produced. These production and cost reports furnish the administrative officers with a means of controlling the manufacturing operations. In any continuous-process plant producing a large number of products the cost of each of which must be separately calculated, much greater detail is required than in a plant producing a single product. But in all cases the only cost obtainable is the average cost per unit of a certain product for a given period.

39. **Job-Order Factories.**— Quite different is the method followed in a job-order factory. The difference may be made clear by reference to several types of job-order factories. The first one taken for illustration will be a paper-box factory.

Paper-box manufacturers do not carry boxes in stock ready to be shipped at a moment's notice to customers. When a customer wants boxes, unless the order is a repeat order, he asks the box manufacturer for a quotation on the particular style of box he needs. If the price quoted is satisfactory, the customer gives his order to the manufacturer for the number of boxes wanted. It is then necessary for the manufacturer to notify the factory what is required by issuing a *production order* giving complete specifications of the box, its size, material, style, lid, and finish. The *production-order blank* must be so skillfully designed, and, when made out for a particular order, it must be filled in so completely, that a workman does not have to look any place other than at the order to find out just what materials are to be used, and what operations must be performed in proper sequence. *During the progress of the job through the shop the production order accompanies it. The material used on the job and the time spent on each operation are charged up directly to the production-order number,* so that when the boxes are finished, the calculation of cost can be made. The issuing of a production order constitutes

the authority of the factory to draw material and to do work on a job. The cost sheet for the job gives the exact cost of the boxes made on that job, and the figures, made available as soon as possible after the job is completed, enable the proprietor to see whether or not his original estimate was too low, too high, or reasonably correct. What has been said about production orders and costs in paper-box factories applies equally well to job printers, lithographers, and kindred lines of manufacture.

The woodworking industries furnish many good illustrations of job-order factories. Take, for example, a furniture factory specializing on chairs. It is necessary to give the factory a production order containing complete instructions regarding just what is wanted before the pieces of lumber can be cut up into the necessary sizes in the mill and afterwards assembled into the completed article in the cabinet-making department. The order must also state how the chairs are to be finished, and whether cushions are required for the seats or backs. Besides enabling the factory to know exactly what kind of chair is required, the production order also furnishes a means for cost keeping, because the cost of lumber and material used, as well as that of the time of the operatives, is charged directly against the job order number. By this means the accountant is enabled to compute the cost of production when the chairs in a job are finished. The exact cost of the chairs in a particular job is figured independently of that of any chairs made on another order. The cost records thus obtained furnish valuable administrative guides, since they show, by means of comparisons, in just what departments or on what jobs there has been an excessive use of material or too large an expenditure of time. The conditions existing in chair factories are found in plants manufacturing all kinds of furniture, mill work, and other wood products.

The textile industry is so large that another reference to it will not be out of place. Take, for purposes of illustration, a weaving mill specializing on fancy cotton shirtings. Such a mill makes a large variety of styles, and it is necessary, before active manufacturing operations can be started, that the overseer of the weaving room be given exact instructions regarding the fabrics wanted. He must know exactly how many threads there are to be per inch in the filling and the warp, what kind of yarn to use, and the arrangement of yarn

needed to meet the requirements of the design, so that he can prepare the warps and then weave the cloth. A separate order must be given for each warp, and the order entered in a special book kept for the purpose. Fabrics are produced at a certain rate, depending on the number of threads to the inch in the filling. With this information, and the starting date as shown by the warp book, the superintendent can calculate when a loom will be available for weaving another fabric. The cost of each warp woven on a production order must be figured like the cost in any job-order factory. The yarn used and the time spent on preparing and weaving each warp must be reported against the individual job so as to make possible the cost calculation.

40. Cost Mechanism.— The material, labor, and overhead-expense records operated in connection with the production system for the purposes of obtaining the cost of manufacture are frequently referred to as the *cost mechanism.* In order to make the cost mechanism clear, and to show how the elements of cost are assembled for the purpose of obtaining the cost of a unit of the product, reference will be made to the procedure in typical process and job-order factories. The mixture of the elements remains fairly constant in a process factory, whereas the relation and proportion of these elements are likely to change with various orders in a job-order factory. It is because of this continual shifting of relationships that the routine of cost finding must here be different from that of a process factory, and the difference must be such as to enable a prompt detection of absolute amounts and, consequently, of the relationship of one element to another entering into the total cost.

41. Process Cost System.— A typical production report and cost forms such as one would expect to find in a process plant are shown in Exhibit C. The production report (A) might be used in a marble quarry, tannery, or cotton mill. This production report shows for a given period the total quantity of product turned out by the plant. From it, on the one hand, the executive obtains information as to the output for administrative purposes, while, on the other, the cost department uses the data for its calculations. The report of stores issued (B) shows the quantity of raw hides, bales of cotton, sorted wool, or other material put into process. When priced and extended, this report gives the material cost. The payroll distribu-

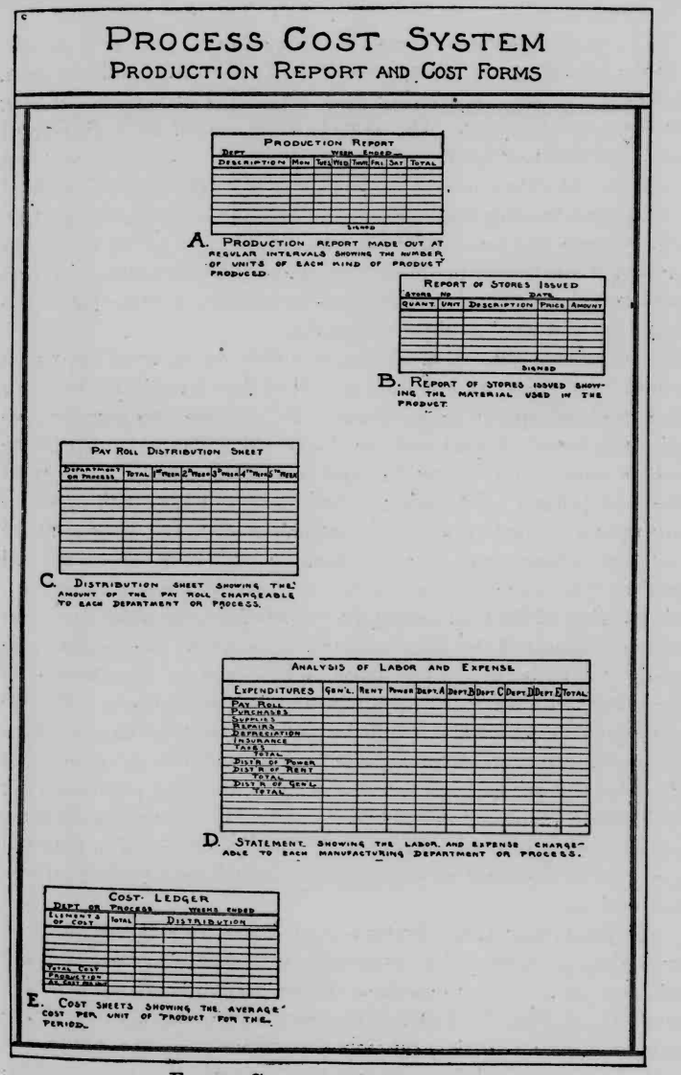


EXHIBIT C. PROCESS COST SYSTEM

tion sheet (C) provides a means of segregating the payroll by departmental classifications or by processes. In a woolen mill the main process divisions are sorting raw wool, spinning yarn, weaving woolens, and finishing. The figures on the payroll are redistributed on the analysis of labor and expense sheet (D), and appear on that analysis under their proper headings, together with items of overhead which must be properly distributed. The sum of raw hides, payroll, and expenses in a sole-leather tannery when divided by the number of pounds of sole leather produced gives the cost of production per pound for the period. Such, in brief, is the general mode of procedure followed for cost finding in process plants.

It is evident that all of the expenditures for material appear on report "B" for a given period, and all of the expenditures for labor and overhead appear on statement "D." These two together constitute a record of total cost for the period. The next step in the system consists in entering this total on a blank like "E," known as the Cost Ledger. The ruling of this blank will vary with every industry and the organization of a particular plant, but in general the left-hand column, here given the heading, "Elements of Cost," will contain: (1) material costs, with total in first column and then a distribution of the total among the various products which are listed in the headings of the other columns to the right, now headed generally "Distribution"; (2) labor and expense by departments, if they exist, with the total which was supplied on statement "D" appearing in the first column and the apportionment in the columns to the right. Near the bottom of the Cost Ledger form is entered first the total cost for each article, and below it the total production for each article from production report "A." The last entries are those of the average cost per unit for each kind of article. The figure in each case is the result obtained by dividing the total production into the total cost.

42. Job-Order Cost System.— In a job-order factory work is authorized by means of a production order bearing a number, and all material and labor expended on the job are charged to the job number. Exhibit D illustrates the routine followed in a typical job-order factory in finding the cost of production. The production order (A) might call for a straw hat, a lot of paper boxes, or a lithographing job. When the factory superintendent receives the order

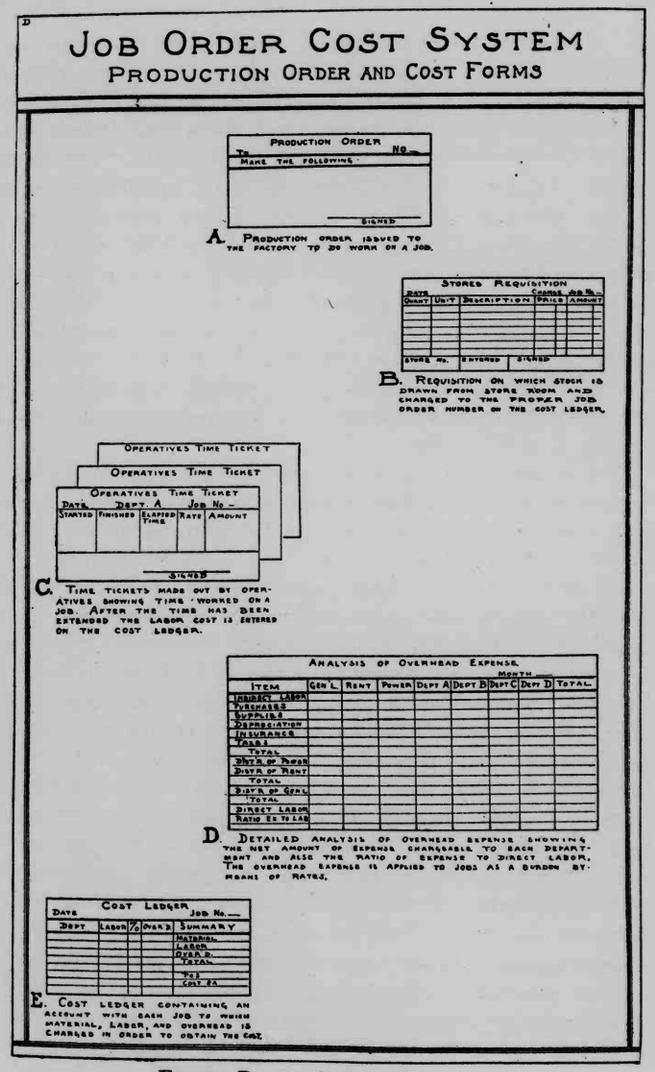


EXHIBIT D. JOB-ORDER COST SYSTEM

"A" filled out by the office, he draws the necessary stores on a requisition (B). When priced and extended, the requisition gives the cost of raw material used on the job. Operatives turn in time tickets (C) showing the time spent on each job. When figured, these tickets furnish the means of arriving at the labor cost on jobs. The analysis of overhead expense (D) shows the expense by departments and also the ratio of expense to labor. In job-order factories the overhead expense is applied to jobs by means of rates which are established in any particular plant according to principles to be explained later. For each production order there is a sheet in the Cost Ledger (E) containing an account with the job. The material requisitions and time tickets are posted to the Cost Ledger. Then the overhead expense is added by means of rates, as, for example, a percentage of the labor cost. The sum of the material, labor, and overhead expense gives the total cost of the job.

43. **Summary.**— The type of production system in operation in a factory determines to a large extent the kind of cost system needed. The routine or cost mechanism in a process plant provides for assembling the elements of cost by processes. Then the total cost of a process is divided by the output reported for the period in order to obtain the cost of a unit of the product. In a job-order factory the material, labor, and overhead expense is summarized for each job. The number of pieces produced on the job divided into the total cost of the job gives the cost per piece. Examples of process plants are mines, quarries, tanneries, chemical factories, and bleacheries. Extractive industries and most plants turning out a single kind of standard product belong to the process type. Most factories in which a variety of products are made from many kinds of raw material belong to the job-order class. Examples of job-order factories are job printers, lithographers, paper-box makers, jewelry establishments, furniture factories, automobile and motor-truck building plants. The mechanical or assembling industries are largely of this type. If overhead expense is applied to the product as a burden by means of hourly or percentage rates, one can be pretty sure that a job-order cost system is in operation. It is essential in approaching the problem of cost finding in any industry that the type of industry be definitely determined at the outset in order that the proper kind of cost system may be installed.

Questions on Chapter IV

1. What is the relation of the cost to the production system?
2. (*a*) How is production controlled in a continuous-process plant?
   (*b*) In a job-order plant?
3. Describe the cost mechanism suited to meet the needs of a process plant.
4. To what class of industries do the extractive enterprises belong?
5. What use is made of production reports in continuous-process plants?
6. When is the cost calculation usually made in process plants?
7. Describe the cost mechanism suited to meet the needs of a job-order factory.
8. What is the purpose of production orders in a job-order factory?
9. When is the cost calculation made in a job-order factory?
10. What points of similarity are there between the cost mechanism in a process and a job-order factory?
11. (*a*) Name three industries where a process cost system is required.
    (*b*) Three where a job-order system is required.
12. Illustrate the operation of a process cost system by filling out a set of cost forms such as shown in Exhibit C.
13. Do the same for a job-order cost system by using forms shown in Exhibit D.
14. Show how the entries would appear on the cost sheet of a printery for the following job: 100,000 sheets of paper used at $1.25 per pound (20 lb. per ream of 500 sheets), composition labor and expense 100 hours at $2 per hour; presswork labor and expense, 50 hours, at $4.50 per hour; and outside bindery work at $100.
15. Show how the calculation would appear on a cost sheet for binding 50,000 copies of a magazine; the operations were: cutting labor, 4 hours at $3 per hour; folding labor, 50 hours at $4 per hour; wire stitching labor, 100 hours, at $1.25 per hour; and trimming labor, 4 hours, at $2.50 per hour. The overhead expense is 50 per cent of the labor cost.

CHAPTER V

COST ACCOUNTS

44. Interlocking Devices.— In putting a cost system into operation it is necessary to provide for interlocking the records of material, labor, and overhead expense with the controlling cost accounts in the ledger. For instance, if the ledger should show for a given period that the company paid out to other concerns a certain sum of money for materials, and paid out for payrolls other sums, and further met other overhead charges for goods and services, and it appeared that after giving proper credit to the concern for material in stock that a larger expenditure appeared in the cost records than actually appeared in the ledger of the firm, obviously those cost records are inaccurate and misleading. A cost system should be so devised that it can be easily checked with the general books of the business. *Each means of adjusting the cost records with the general financial records is known as an interlocking device.* Furthermore, the operation of an interlocking cost system furnishes a means for preparing monthly statements of the condition of the business without waiting to take a physical inventory of materials and stock on hand. The preparation of a monthly balance sheet and profit and loss account is a part of the routine in connection with the operation of a complete cost system in either a process or a job-order factory.

45. Chart of Cost Accounts.— The ledger accounts that have to do with the cost of manufacturing and selling the product are shown in Exhibit E. There are two main classes of accounts. Those accounts in the upper portion of the " Chart of Cost Accounts " have to do with the cost of production, while those in the lower part of the chart pertain to the trading or merchandising end of the enterprise. The cost accounts which carry inventory balances are Supplies, Raw Material, Work in Process, and Finished Goods. The Cost of Sales and Selling Expense accounts are closed out to Profit and Loss at the end of each accounting period. The operation of the various accounts will be explained in detail.

CHART OF COST ACCOUNTS

A. MANUFACTURING SECTION
(COST OF PRODUCTION)

ACCOUNT No. 10 SUPPLIES

1 INVENTORY	$ 10,000.00	31 STORES REQUISITIONS	$ 6,500.00
31 PURCHASES	5,000.00	31 BALANCE, INVENTORY	8,500.00
	$ 15,000.00		$ 15,000.00
1 BALANCE BROUGHT DOWN	$ 8,500.00		

ACCOUNT No 11 RAW MATERIAL

1 INVENTORY	$ 75,000.00	31 STORES REQUISITIONS	$ 200,000.00
31 PURCHASES, INC. FRT.	250,000.00	31 BALANCE, INVENTORY	125,000.00
	$ 325,000.00		$ 325,000.00
1 BALANCE BROUGHT DOWN	$ 125,000.00		

ACCOUNT No 12 WORK IN PROCESS

1 INVENTORY	$ 150,000.00	31 COST OF PRODUCTION	$ 400,000.00
31 RAW MATERIAL REQ	200,000.00	31 BALANCE, INVENTORY	100,000.00
DIRECT LABOR, DEPT A	100,000.00		
DEPT B			
OVERHEAD EXPENSE, DEPT. A	50,000.00		
DEPT. B			
	$ 500,000.00		$ 500,000.00
1 BALANCE BROUGHT DOWN	$ 100,000.00		

ACCOUNT No 60 OVERHEAD EXPENSE DEPT. A

INDIRECT LABOR	$ 11,000.00	31 WASTE SOLD	$ 1,000.00
PURCHASES	4,000.00	31 WORK IN PROCESS	50,000.00
SUPPLIES REQUISITIONS	6,500.00		
REPAIRS	12,000.00		
POWER	6,000.00		
BUILDING AND OCCUPANCY EXP.	2,400.00		
GENERAL EXPENSE	2,500.00		
DEPRECIATION	400.00		
INSURANCE	150.00		
TAXES	50.00		
	$ 51,000.00		$ 51,000.00

B. TRADING SECTION
(COST OF SALES)

ACCOUNT No 13 FINISHED GOODS

1 INVENTORY	$ 350,000.00	31 COST OF SALES	$ 505,000.00
31 WORK IN PROCESS	400,000.00	31 BALANCE, INVENTORY	245,000.00
	$ 750,000.00		$ 750,000.00
31 BALANCE BROUGHT DOWN	$ 245,000.00		

ACCOUNT No 70 COST OF SALES

31 FINISHED GOODS	$ 505,000.00		

ACCOUNT No 71 SELLING EXPENSE

31 PAY ROLL	$ 50,000.00		
COMMISSIONS	17,000.00		
TRAVELING EXPENSE	20,000.00		
ENTERTAINMENT	4,000.00		
SUPPLIES	1,000.00		
REPAIRS	500.00		
BUILDING AND OCCUPANCY EXP.	2,500.00		
GENERAL EXPENSE	15,000.00		
FIXED CHARGES	2,000.00		
DEPR. $ 300.00			
TAXES 1,700.00			
	$ 112,000.00		

EXHIBIT E. CHART OF COST ACCOUNTS

46. *Supplies Account (Account No. 10).*— When factory supplies are purchased and put in stock, they are charged to an inventory account and remain on hand as an asset until such time as they are issued on stores requisitions. The amount of supplies used is credited to the Supplies account and charged to the Overhead Expense account of the department using them, as shown (Account No. 60). The balance to the Supplies account is brought down at the close of the period and represents the inventory value of the unused supplies.

47. *Raw Material Account (Account No. 11).*— The purchases of raw material are charged to the Raw Material account. At the end of the period the account is credited for the total amount of raw material issued on stores requisitions, the charge being made to the Work in Process account (Account No. 12). The balance then represents the inventory value of raw material on hand.

48. *Work in Process Account (Account No. 12).*— The most important of the cost accounts is the Work in Process account, which is charged for raw material, direct labor, and overhead expense as shown. At the close of each period this account is credited for the total cost of production, as shown by the process or job cost sheets, the charge being made to Finished Goods account (Account No. 13). This entry takes the factory product out of the "Manufacturing Section" and transfers it to the "Trading Section," as shown. The balance of the Work in Process account represents the inventory value of the partly finished goods at the end of the month.

49. *Overhead Expense (Department A) Account (Account No. 60).*— The various items of expense going to make up the overhead of a manufacturing department are charged to an Overhead Expense account. Waste sales are an offset to the expense of running a department. At the close of each accounting period an entry is made charging the Work in Process account for the amount of overhead expense applied on the product for the period, the credit being made to the Overhead Expense account, as shown.

In a process factory the total overhead expenses are closed directly into the Work in Process account. But in a job-order plant the amount of overhead expense charged to the Work in Process account depends upon the rates used and the amount of the direct labor or hours in the various departments. In the *pro-forma* accounts given in Exhibit E the ratio of overhead expense to direct labor in Department A happens to be 50 per cent. If, in the case of a job-order plant, the actual expenses are more than those applied to costs by means of rates, there remains a debit balance to the Overhead Expense account, thus indicating that the rates used were too low. In case the actual expenses were less than those applied to costs by means of rates, a credit balance would remain, thus indicating that the rates used were too high. In every job-order cost system the use of rates for applying overhead to the product generally results in leaving a balance in the Overhead Expense account. If the balance is small, the usual practice is to close it out to Profit and Loss, otherwise some special disposition of it has to be made.

50. *Finished Goods Account (Account No. 13).*— The first account appearing under the "Trading Section" is that for finished goods. Obviously, the total represents the total *cost to make* of all the goods on hand. This account is charged for the production of finished goods, the credit being made to the Work in Process account. At the end of each accounting period the sales are priced at cost and an entry is made crediting the Finished Goods account and charging the Cost of Sales account, as shown. The balance at the end of the period to the Finished Goods account is brought down as shown, and represents the inventory value of merchandise on hand.

51. *Cost of Sales Account (Account No. 70).*— To the Cost of Sales account is charged the *cost to make* of all of the merchandise shipped out during the period. Merchandise returned by customers is credited to this account at cost. At the end of the month the account is closed out to Profit and Loss.

52. *Selling Expense Account (Account No. 71).*— The salaries of salesmen and all expenses incurred in connection with selling the merchandise are charged to the Selling Expense account. At the end of the month this account is closed out to Profit and Loss.

53. **Factory Ledger.**— The cost accounts are sometimes removed from the General Ledger and kept in a Factory Ledger. When accounts are thus removed, some account has to be set up in the General Ledger to take their place. The name of the account in this case is "Factory Ledger." When the manufacturing plant is removed from the main office, it is frequently desirable to keep the Factory Ledger at the plant and the General Ledger at the main office. If this is the practice, the Factory Ledger account in the

General Ledger is said to be a controlling account for the Factory Ledger.

54. Method of Controlling the Factory Ledger.— When cost accounts are kept on the Factory Ledger, it is necessary to open a "General Ledger" account in it. The method of operating this ac-

CHART SHOWING METHOD OF CONTROLLING THE FACTORY LEDGER

FACTORY LEDGER

Account No 80	General Ledger		
31 Waste Sales	$ 1,000.00	1 Inventory	$ 585,000.00
31 Balance	1,095,500.00	31 Purchases, Including Direct Cash Items	347,900.00
		Depreciation	900.00
		Insurance	1,350.00
		Taxes	350.00
		Pay Roll	161,000.00
	$ 1,096,500.00		$ 1,096,500.00
		1 Balance Brought Down	$ 1,095,500.00

GENERAL LEDGER

Account No 100	Factory Ledger		
1 Inventory	$ 585,000.00	31 Waste Sales	$ 1,000.00
31 Purchases Including Direct Cash Items	347,900.00	31 Balance	1,095,500.00
Depreciation	900.00		
Insurance	1,350.00		
Taxes	350.00		
Pay Roll	161,000.00		
	$ 1,096,500.00		$ 1,096,500.00
1 Balance Brought Down	$ 1,095,500.00		

NOTE:- The credit balance to the General Ledger account in the Factory Ledger offsets the debit balance to the Factory Ledger account in the General Ledger when the trial balances of the two ledgers are combined.

EXHIBIT F. FACTORY LEDGER CONTROL

count will be readily understood by referring to Exhibit F. An illustrative transaction will make the procedure clear. When raw material is purchased for the factory, the entry would be to make a charge to Raw Material account in the Factory Ledger and a corresponding credit to the General Ledger account. The reason for this

credit entry is that the Accounts Payable account is not carried in the Factory Ledger.

The General Ledger account in the Factory Ledger always has a credit balance to offset the balances to the inventory accounts. The Factory Ledger account in the General Ledger always has a debit balance to take the place of the inventory accounts which have been transferred to the Factory Ledger. From this description of the operation of the Factory Ledger one can readily see how the trial balance from the General Ledger can be consolidated with the one taken from the Factory Ledger when making up a balance sheet. In Exhibit F the credit balance of $1,095,500 to the General Ledger account offsets the debit balance of the same amount to the Factory Ledger account.

55. Journal Entries.— The journal entries made to the cost accounts shown in Exhibits E and F are as follows:

FACTORY JOURNAL

1. Opening Inventory

Dr. Supplies	$ 10,000.00	
Raw Material	75,000.00	
Work in Process	150,000.00	
Finished Goods	350,000.00	
Cr. General Ledger		$585,000.00

2. Purchases from Purchase Journal Distribution

Dr. Supplies	$ 5,000.00	
Raw Material	250,000.00	
Overhead Expense:		
Sundry Purchases	4,000.00	
Repairs	12,000.00	
Power	8,000.00	
Building and Occupancy Expense	2,400.00	
General Expense	6,500.00	
Selling Expense:		
Commissions	17,000.00	
Traveling Expense	20,000.00	
Entertainment	4,000.00	
Supplies	1,000.00	
Repairs	500.00	
Building and Occupancy Expense	2,500.00	
General Expense	15,000.00	
Cr. General Ledger		$347,900.00

3. Payroll for Period

Dr. Work in Process	$100,000.00	
Overhead Expense	11,000.00	
Selling Expense	50,000.00	
Cr. General Ledger		$161,000.00

4. Estimated Amount of Fixed Charges for Period

Dr. Overhead Expense:			
Depreciation		$ 400.00	
Insurance		150.00	
Taxes		50.00	
Selling Expense:			
Depreciation		500.00	
Insurance		1,200.00	
Taxes		300.00	
Cr. General Ledger			$ 2,600.00
Depreciation	$ 900.00		
Insurance	1,350.00		
Taxes	350.00		

5. Waste Sales

Dr. General Ledger	$ 1,000.00	
Cr. Overhead Expense		$ 1,000.00

6. Raw Material Stores Requisitions

Dr. Work in Process	$200,000.00	
Cr. Raw Material		$200,000.00

7. Supplies Requisitions

Dr. Overhead Expense	$ 6,500.00	
Cr. Supplies		$ 6,500.00

8. Overhead Expense Applied as a Burden to the Product

Dr. Work in Process	$ 50,000.00	
Cr. Overhead Expense		$ 50,000.00

NOTE.— In a process cost system this entry is omitted and overhead-expense charges are debited directly to the departmental work in process accounts. The reason for opening the Overhead Expense account in job-order factories is for the purpose of ascertaining the rates used in cost calculations.

9. Cost of Production per Cost Summary Sheets

Dr. Finished Goods	$400,000.00	
Cr. Work in Process		$400,000.00

10. Cost of Finished Goods Sold

Dr. Cost of Sales	$505,000.00	
Cr. Finished Goods		$505,000.00

The foregoing entries are typical of the entries that have to be made to the cost accounts every month.

56. Trial Balance of Factory Ledger.— After the foregoing entries have been posted the trial balance of the Factory Ledger appears as follows:

TRIAL BALANCE

Supplies	$ 8,500.00	
Raw Material	125,000.00	
Work in Process	100,000.00	
Finished Goods	245,000.00	
Cost of Sales	505,000.00	
Selling Expense	112,000.00	
General Ledger		$1,095,500.00
	$1,095,500.00	$1,095,500.00

57. Control of Inventory Accounts.— In order to operate a cost system properly it is necessary to provide some means for controlling the inventory. The usual plan of procedure is to put into operation subsidiary ledgers for the purpose of showing the details of the balances to Supplies, Raw Material, Work in Process, and Finished Goods accounts. A detailed description of these subsidiary ledgers will be given and their relation to the cost system explained.

58. Raw Material Stores Ledger.— When the inventory of raw material is taken, it is entered in detail on the Raw Material Stores Ledger, Form 1. A separate card is used for each article. When raw material is received, it is entered on the proper card in the Raw Material Stores Ledger. Provision is made for showing the complete details of each lot received. The total amount of raw material received and entered on the various cards comprising the Raw Material Stores Ledger must agree with the debit entry to the Raw Material account in the Factory Ledger. All raw material stores requisitions have to be posted in the issued columns shown on Form 1 and must agree with the credit entries to the Raw Material account. The difference between the sum of the initial inventory and purchases and the issues gives the balance on hand, which is entered in the columns at the extreme right of Form 1. The proof of the accuracy of the Raw Material Stores Ledger is obtained by taking off a trial balance and comparing it with the balance to the controlling Raw

Material account on the main ledger. If the two agree, it proves that the clerical work has been done correctly. At inventory time the balances on the individual Stores Ledger cards are checked with the actual count of stock and any discrepancies are adjusted. The ordered columns provide a means of keeping a memorandum of goods ordered. The provision made for indicating minimum and maxi-

RAW MATERIAL STORES LEDGER

ARTICLE UNIT CLAS'N. NO. MAX. MIN.

Ordered				Received					Issued					Balance		
Date	Order Number	Vendor	Quant.	Date	Pur. Ord. No.	Quant.	Price	Amount	Date	Prod. Ord. No.	Quant.	Price	Amount	Date	Quant.	Amount

FORM 1. RAW-MATERIAL STORES LEDGER

mum stock limits is for the purpose of showing when to place an order for replenishing the stock of an article and, also, how much to order.

The form of stock card used for the purpose of keeping a record of the balance of supplies on hand is similar to the one used for raw material, and consequently a separate form is not illustrated.

59. Work in Process Ledger.— The elements of cost have to be assembled on the Work in Process Ledger, Form 2. Every item of material, labor, and overhead expense charged to a process or a job has to be entered, not only in detail on Form 2, but also in total on the Work in Process controlling account in the Factory Ledger. The form of Work in Process Ledger illustrated provides for the job number in a job-order cost system where a separate ledger sheet is opened for each job. All stores requisitions that are entered on the issued side of the Raw Material Stores Ledger are posted to the debit of some Work in Process account. The time tickets turned in by

operatives have to be extended and posted to the Work in Process Ledger, and finally, when jobs are finished, the overhead must be added, the cost summarized and the sheets for finished jobs transferred from the active file. A credit entry is then made to the controlling Work in Process account as previously explained, the charge being to Finished Goods account.

WORK IN PROCESS LEDGER

DESCRIPTION JOB NO.

MATERIAL

Department	Labor	Overhead Rate	Overhead Amount	Recapitulation		Remarks
				Material		
				Labor		
				Overhead		
				Total		
				No. of Pieces		
				Cost per Piece		

FORM 2. WORK IN PROCESS LEDGER

In process factories the Work in Process Ledger usually consists of columnar sheets on which the costs of manufacture are analyzed each month.

At inventory time the Work in Process Ledger should be closed; that is, each job should be figured as if finished. A trial balance of the ledger then gives the value of goods in process, and it should agree with the balance to the Work in Process controlling account in the General or Factory Ledger.

60. Finished Goods Stock Ledger.— When finished goods are carried in stock a control is established over them by means of the ledger shown in Form 3. The initial inventory and all goods received in the finished-goods stockroom are entered on the received side of the ledger, and all goods sold are entered on the sold side, the balance being carried in the extreme column to the right. The or-

3

FINISHED GOODS STOCK LEDGER

ARTICLE _____ UNIT _____ CLAS'N No. _____ MAX _____ MIN. _____

ORDERED			RECEIVED					SOLD					BALANCE		
DATE	ORD NO.	QUANT	DATE	ORD NO	QUANT	PRICE	AMOUNT	DATE	INVOICE No	QUANT	PRICE	AMOUNT	DATE	QUANT	AMOUNT

FORM 3. FINISHED GOODS STOCK LEDGER

4

THE A. B. CO.

TRIAL BALANCE

JAN. 31, 19

NAME OF ACCOUNT	DEBITS	CREDITS	ASSETS	LIABILITIES	LOSSES	PROFITS
1 CASH	50,000.00		50,000.00			
2 ACCOUNTS RECEIVABLE	275,000.00		275,000.00			
3 NOTES RECEIVABLE	10,000.00		10,000.00			
10 SUPPLIES	8,500.00		8,500.00			
11 RAW MATERIAL	125,000.00		125,000.00			
12 WORK IN PROCESS	100,000.00		100,000.00			
13 FINISHED GOODS	245,000.00		245,000.00			
20 LAND	100,000.00		100,000.00			
21 BUILDINGS	250,000.00		250,000.00			
22 MACHINERY AND EQUIPMENT	300,000.00		300,000.00			
30 INSURANCE PREPAID	1,000.00		1,000.00			
40 ACCOUNTS PAYABLE		150,000.00		150,000.00		
41 NOTES PAYABLE		5,000.00		5,000.00		
50 TAXES ACCRUED		500.00		500.00		
51 RESERVE FOR DEPRECIATION		110,000.00		110,000.00		
60 CAPITAL		1,000,000.00		1,000,000.00		
61 SURPLUS		117,000.00		117,000.00		
70 COST OF SALES	505,000.00				505,000.00	
71 SELLING EXPENSE	112,000.00				112,000.00	
72 INTEREST	1,000.00				1,000.00	
80 SALES		700,000.00				700,000.00
TOTALS	2,082,500.00	2,082,500.00	1,464,500.00	1,382,500.00	618,000.00	700,000.00
NET PROFIT				82,000.00	82,000.00	
			1,464,500.00	1,464,500.00	700,000.00	700,000.00

FORM 4. TRIAL BALANCE

5

THE A. B. CO.

BALANCE SHEET

AS AT THE CLOSE OF BUSINESS, JAN. 31, 19

ASSETS			LIABILITIES AND NET WORTH		
CURRENT ASSETS			CURRENT LIABILITIES		
CASH		$ 50,000.00	ACCOUNTS PAYABLE		$ 150,000.00
ACCOUNTS RECEIVABLE		275,000.00	NOTES PAYABLE		5,000.00
NOTES RECEIVABLE		10,000.00	TOTAL CURRENT LIABILITIES		$ 155,000.00
INVENTORIES					
SUPPLIES		8,500.00			
RAW MATERIAL		125,000.00	OTHER LIABILITIES		
WORK IN PROCESS		100,000.00	TAXES ACCRUED		500.00
FINISHED GOODS		245,000.00	TOTAL LIABILITIES		$ 155,500.00
TOTAL CURRENT ASSETS		$ 813,500.00			
OTHER ASSETS					
LAND		100,000.00	NET WORTH		
BUILDINGS	$ 250,000.00		CAPITAL	$ 1,000,000.00	
MACHINERY AND EQUIPMENT	300,000.00		SURPLUS	117,000.00	
	$ 550,000.00		PROFIT FOR JANUARY, 191.	82,000.00	
LESS RESERVE FOR DEP'N	110,000.00	440,000.00	TOTAL NET WORTH		1,199,000.00
INSURANCE PREPAID		1,000.00			
TOTAL ASSETS		$ 1,354,500.00	TOTAL LIABILITIES AND NET WORTH		$ 1,354,500.00

FORM 5. BALANCE SHEET

dered columns provide a means for keeping a record of goods ordered from the factory or from outside sources of supply. At inventory time the balances to the Finished Goods Stock Ledger have to be checked against a physical count and any discrepancies adjusted. A trial balance from the Finished Goods Stock Ledger should agree with the balance to the Finished Goods controlling account in the Factory or General Ledger.

61. Trial Balance.— In order to show the relation of the cost accounts to the other accounts appearing on a typical ledger, the Trial Balance, Form 4, has been prepared. One of the main features to be observed in this Trial Balance is that no adjustments are required to be made in order to close the books and make up a Balance Sheet and Profit and Loss account. The reason for this is that the book balances to the Supplies, Raw Material, Work in Process, and Finished Goods accounts represent the inventory values. Hence, one can at once proceed to segregate the debits and credits between assets, liabilities, losses and profits, as shown. The net profit for the period covered is seen to be $82,000.

62. Balance Sheet.— When the assets and liabilities appearing on the trial balance are set up in a balance sheet they appear as shown

THE A. B. CO.

PROFIT AND LOSS ACCOUNT

FOR JANUARY, 19

A. MANUFACTURING SECTION

INVENTORY, JAN. 1, 19			BALANCE, COST OF PRODUCTION CARRIED DOWN TO TRADING SECTION.	$400,000.00
RAW MATERIAL	$75,000.00			
WORK IN PROCESS	150,000.00	$225,000.00		
PURCHASES				
RAW MATERIAL		250,000.00		
		$475,000.00		
LESS, INVENTORY JAN. 31, 19				
RAW MATERIAL	$125,000.00			
WORK IN PROCESS	100,000.00	225,000.00		
COST OF MATERIAL		250,000.00		
DIRECT LABOR		100,000.00		
OVERHEAD EXPENSE		50,000.00		
		$400,000.00		$400,000.00

B. TRADING SECTION

INVENTORY, JAN. 1, 19:			SALES	$700,000.00
FINISHED GOODS	$350,000.00			
COST OF PRODUCTION BROUGHT DOWN	400,000.00	$750,000.00		
LESS INVENTORY JAN. 31, 19		245,000.00		
COST OF SALES		505,000.00		
BALANCE, GROSS PROFIT ON TRADING CARRIED DOWN TO PROFIT AND LOSS		195,000.00		
		$700,000.00		$700,000.00

C. PROFIT AND LOSS SECTION

SELLING EXPENSE	$112,000.00		GROSS PROFIT ON TRADING BROUGHT DOWN	$195,000.00
INTEREST	1,000.00			
BALANCE, NET PROFIT CARRIED TO SURPLUS		82,000.00		
		$195,000.00		$195,000.00

FORM 6. PROFIT AND LOSS ACCOUNT

in Form 5. The Balance Sheet is arranged in statement form. The current assets are given first and the other assets last on the left-hand side. Accordingly, the current liabilities come first on the right-hand side. The profit for the period of $82,000 is shown added to the net worth. This is the usual form followed in arranging the balance sheet for a manufacturing enterprise, more interest being taken in the current assets and liabilities than in the other items.

In industrial enterprises like mines and quarries, where the investment in property is of enormous size, it is frequently the practice to reverse the procedure and place the plant in the first position on the asset side and the current assets last. If this is done, the capital items come first on the right-hand side.

7

THE A. B. CO.

ANALYSIS OF SALES

FOR JANUARY, 19—

QUALITY NUMBER	YARDS	SALES		COST OF SALES		PROFIT		LOSS	
		AMOUNT	PER YARD	AMOUNT	PER YARD	AMOUNT	PER YARD	AMOUNT	PER YARD
1	10000	$10,000.00	$1.00	$8,000.00	$.80	$2,000.00	$.20		
2	4,545	5,000.00	1.10	4,500.00	.99	500.00	.11		
3	14,167	17,000.00	1.20	15,000.00	1.06	2,000.00	.14		
4	30,769	40,000.00	1.30	44,000.00	1.43			$4,000.00	$.13
5	714	1,000.00	1.40	1,000.00	1.40				
6	8,000	12,000.00	1.50	8,000.00	1.00	4,000.00	.50		
7	20,937	33,500.00	1.60	35,000.00	1.67			1,500.00	.07
8	10,294	17,500.00	1.70	11,000.00	1.07	6,500.00	.63		
9	66,666	120,000.00	1.80	80,000.00	1.20	40,000.00	.60		
10	6,868	13,050.00	1.90	10,000.00	1.46	3,050.00	.44		
11	10,125	20,250.00	2.00	15,000.00	1.48	5,250.00	.52		
12	2,476	5,200.00	2.10	4,000.00	1.61	1,200.00	.49		
13	45,680	100,500.00	2.20	60,000.00	1.31	40,500.00	.89		
14	43	100.00	2.30	90.00	2.09	10.00	.21		
15	13,333	32,000.00	2.40	20,000.00	1.50	12,000.00	.90		
16	4,000	10,000.00	2.50	7,500.00	1.87	2,500.00	.63		
17	27,115	70,500.00	2.60	50,000.00	1.84	20,500.00	.76		
18	7,407	20,000.00	2.70	17,000.00	2.29	3,000.00	.41		
19	3,946	11,050.00	2.80	10,000.00	2.53	1,050.00	.27		
20	55,637	161,350.00	2.90	104,910.00	1.88	56,440.00	1.02		
TOTAL		$700,000.00		$505,000.00		$200,500.00		$5,500.00	

RECAPITULATION

PROFIT	$200,500.00
LOSS	$5,500.00
	$195,000.00

FORM 7. ANALYSIS OF SALES

63. Profit and Loss Account.— A Profit and Loss account is presented in Form 6 for the purpose of bringing out the relation of the accounts appearing in the chart of cost accounts, Exhibit E, to those appearing on Form 6. In the "Manufacturing Section" one sees how the cost is arrived at. The cost of production, amounting to $400,000, is carried down to the "Trading Section" as shown in Form 6. Then the cost of sales is calculated and found to be $505,000 which, deducted from the sales of $700,000, gives $195,000 to be carried down to the last section, as shown. Finally, the net profit for the period is found to be $82,000, which agrees with the figures shown on the Balance Sheet.

The usual practice is to set up the Profit and Loss account in report rather than account form, because a report is considered easier to read.

64. Analysis of Sales.— It is quite necessary to supplement the Profit and Loss statement with an analysis of sales, such as shown in

Form 7. The reason for this is that although the business as a whole may make a reasonably good showing, it is likely that some line is being sold at a loss. If this is the case, the loss is being carried by the profitable lines. Form 7 shows how an analysis of sales should be set up in order to bring out the profit and loss on the various items sold. In addition to showing amounts, provision is made for giving unit costs. In the case taken for the purpose of illustration, a profit was made on all but two qualities, and on these two a loss of $5,500 was sustained, as shown in Form 7. Such an analysis is an invaluable guide to the executive in watching the trend of the business.

65. Summary.— It is necessary to provide a means for interlocking the cost records with the controlling accounts in the General Ledger. This is accomplished by exercising control over the inventory by means of subsidiary Supplies, Stores, Work in Process and Finished Goods ledgers. At the close of each month the book balances to the Supplies, Stores, Work in Process and Finished Goods accounts represent the inventory values. A Balance Sheet and Profit and Loss account can then be set up without the necessity of taking an inventory and making the necessary adjustments to the book balances. In addition to the usual financial statements, an analysis of sales should be prepared showing the profit or loss on each line of merchandise handled. Such an analysis of sales, revealing losses in particular lines, would be impossible without an interlocking cost system.

Questions on Chapter V

1. What is the best plan to follow for controlling costs?
2. Name the cost accounts.
3. (*a*) How is a Raw Material account operated?
   (*b*) A Work in Process account?
4. What plan is followed in charging overhead expense to the Work in Process account in a job-order factory? Illustrate.
5. What purpose is served by a Factory Ledger? How is it controlled?
6. (*a*) What journal entry is made when raw-material stores are issued to the factory?
   (*b*) When supplies are issued to departments?
   (*c*) When goods are finished in the factory?
   (*d*) When merchandise is shipped to customers?
7. How are inventory accounts controlled?
8. What is a Work in Process Ledger?
9. What procedure is followed in making up a Balance Sheet and a Profit and Loss account from the trial balance? Illustrate.

10. What purpose is served by an analysis of sales? Illustrate the form used.
11. From the data contained in the following "Profit and Loss" section of the trial balance taken from the books of the X World-Herald newspaper as of the close of business on December 31, prepare a statement showing the cost per line of advertising. In figuring the "cost per line" of advertising the revenue from circulation and the sale of paper and waste is deducted from the total cost of doing business and the balance divided by the number of lines of advertising, which was 1,255,750.

Trial Balance of the X World-Herald, December 31

Profit and Loss

Circulation Revenue		$100,900
Advertising Revenue		350,150
Discounts Received		3,500
Interest Received		1,000
Sales of Paper and Waste		12,000
Editorial and News Expense	$ 22,000	
Composing Room Expense	25,500	
Stereotyping Expense	5,500	
Pressroom Expense	35,000	
Paper and Ink Expense	100,000	
Selling Circulation Expense	20,000	
Delivering Circulation Expense	7,500	
Selling Advertising Expense	30,000	
Rent Expense	12,000	
General Expense	106,550	
Interest Paid	3,500	

PART II

PRODUCTION AND COSTS

CHAPTER VI

PRODUCTION RECORDS

66. Relation of Production Records to Cost Finding.— A distinction was drawn in Chapter IV between the continuous-process plant and the job-order establishment. The management, as a producer, in the first case may be said to concern itself chiefly with the *rate of flow* of the commodity through the plant. Therefore, a set of forms is devised which, when filled out, will keep the executive informed as to when and how much raw material was put into process, when and how it passed through the various stages, together with the amount of labor, general service, and supplies absorbed on the way. These reports all along the line enable the executive to give orders for increasing or diminishing the rate of flow according to the market demand for the output. As a seller of this same output, the manager wants to know the cost, so that when a thousand units (or any other quantity) for a production period have flowed out as finished articles, he will know exactly what they represent in total cost. Then, by dividing the number into the total cost, he finds the unit cost. These records which give information as to quantity, rate, and cost of production in a continuous-process establishment are called *production reports.* If skillfully designed, they will not only enable the management to determine the unit cost of a finished article, but they will also indicate just how the various *elements* of cost enter and in what relationship, so that inefficiencies in departments or processes on the route of production may be revealed and methods of cost reduction consequently introduced.

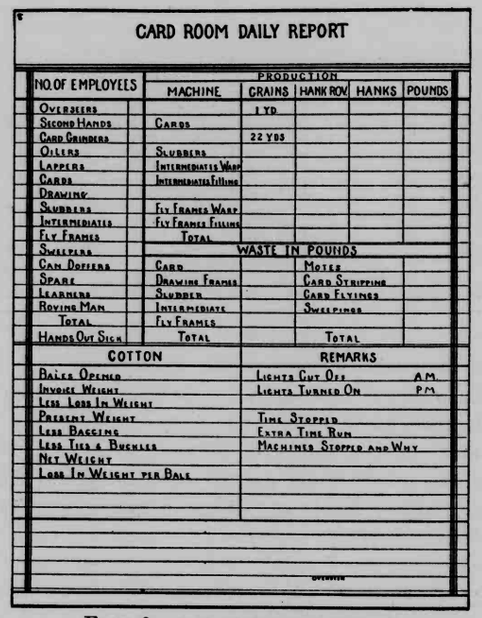
In job-order factories it is necessary to issue a formal *order* for the work to be done. Usually these orders are issued for specific jobs or particular articles. A contract for cutting, polishing, and setting the marble work in an office building represents a job which must be carried out according to certain specifications. Usually production orders are issued by the management in manifold so that

one copy may stay in the office while the other copies go to the departments that are to do work on an order. Individual order forms are so designed as to give directions regarding the material to be used and operations required, and so on. In some cases separate orders are issued for each operation to be performed on a part. The same operation is repeated from time to time, and so one may readily conceive of this method of manufacturing as one of intermittent processes. In the mechanical and allied industries production is controlled by orders specifying the separate operations to be performed on each part, unit, or final assembly.

67. Reports vs. Orders.— These production records (*reports* for the process factory and *orders* for the job-order plant) are sometimes so designed that cost calculations can be completed on the office copy or on one of the manifold duplicates. Sometimes, however, the production organization is such that it is advisable not to use the production records for this purpose, but rather to have a separate *cost* sheet on which facts bearing on costs can be transcribed from the production records. Suggestions concerning the design of production reports, production orders, and cost sheets to comply with the principles relating the production system to the cost-accounting system will be given in this and the next chapter. It is necessary, of course, to be specific and to discuss the various forms in relation to particular industries.

68. Card Room Daily Report.— The first production report to be presented is taken from the card room of a spinning mill where cotton yarn is manufactured. The work of preparing the cotton and making roving is done in the card room of a spinning mill under the direction of the overseer of that department. The production of the card room is measured by the number of hanks or pounds of roving which are made each day. In order that the superintendent of the mill may be advised as to what is going on in the card room, he requires the overseer to furnish him with daily reports. The "Card Room Daily Report" in Form 8 shows what information is required regarding the operations carried on in that room. It will be noticed that provision is made for entering the number of persons employed in each occupation, the production from each class of machines, the cotton opened, the waste made, and data regarding the time of operation. When the superintendent receives this report, he is able to

tell whether or not any changes need to be ordered in the sizes or quantity of roving being produced to insure a proper supply of this product, which becomes the raw material for the spinning room. The information given on this form, together with certain data obtained from the cost accounts, enables the factory accountant to compute the unit cost of the roving.



CARD ROOM DAILY REPORT

NO. OF EMPLOYEES		PRODUCTION				
		MACHINE	GRAINS	HANK ROV.	HANKS	POUNDS
Overseers			1 YD			
Second Hands		Cards				
Card Grinders			22 YDS			
Oilers		Slubbers				
Lappers		Intermediates Warp				
Cards		Intermediates Filling				
Drawing						
Slubbers		Fly Frames Warp				
Intermediates		Fly Frames Filling				
Fly Frames		Total				
Sweepers		WASTE IN POUNDS				
Can Doffers		Card		Motes		
Spare		Drawing Frames		Card Stripping		
Learners		Slubber		Card Flyings		
Roving Man		Intermediate		Sweepings		
Total		Fly Frames				
Hands Out Sick		Total		Total		

COTTON	REMARKS	
Bales Opened	Lights Cut Off	A.M.
Invoice Weight	Lights Turned On	P.M.
Less Loss In Weight		
Present Weight	Time Stopped	
Less Bagging	Extra Time Run	
Less Ties & Buckles	Machines Stopped and Why	
Net Weight		
Loss In Weight per Bale		

Overseer

Form 8. CARD ROOM DAILY REPORT

This daily report form is suggestive also of what information should be given by the overseer of the spinning room of a textile mill to the superintendent, or by the head of any operating department of almost any factory of the continuous-process type to the managers. Such daily production reports are also needed by the cost accountant for calculating the cost of production in the operating departments rendering the reports. A detailed description of the cost sheets upon which the information gleaned from the daily production reports is

9

PRODUCTION SHEET — Order No 123, 30 Engines C.P.

Part No	Frames									Rails									
Operation	Received		Planed		Slotted		Drilled		Assembled	Received		Planed		Slotted		Re Plane Top		Re Plane Bottom		Drilled	
To Begin																					
To Be Finished																					
No Wanted	30		30		30		30		30	60		60		60		30		30		60	
No Finished	Daily	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total
1917 Mar. 5	4	4	4	4							12	12										
6	4	8																				
7			4	8							12	24	12	12								
8	2	10											8	20								
9	4	14	2	10	6	6							4	24	8	8						
11	8	22	4	14	2	8					12	36	8	32	4	12	2	2	2	2		
15																	6	8	6	8		
16	2	24	4	18	6	14	4	4			8	44	8	40	8	20						
19	4	28	2	20	2	16	2	6			8	52	8	48	8	28	4	12	4	12	8	8
20	2	30	2	22	4	20	2	8									2	14	2	14	8	16
21			6	28	2	22	2	10			8	60	4	52	8	36	4	16	4	18		
22					2	24	2	12	2	4			4	56	8	44	2	20	2	20		
23			2	30	2	26	6	18	2	6			4	60	12	56	6	26	6	26	4	20
26							4	22	4	10					8	66	4	30	4	30	8	28
27							4	26	2	12											8	36
28					4	30			4	16											12	48
Apl. 2							4	30	2	18											8	56
3									4	22												
5									2	24											4	60
9									2	26												
10									2	28												
11									2	30												

FORM 9. PRODUCTION RECORD

entered will be postponed until a subsequent chapter in which the method of calculating the cost of production in a cotton spinning mill will be fully presented.

69. Production Record.— In the mechanical and allied industries it often happens that the quantities of parts required for assembly into the finished article are scheduled and ordered to be made in the different operating departments during a certain period of time. Under these conditions it becomes necessary to keep a *production record* (Form 9) which shows the number of parts wanted, daily deliveries, and total deliveries to date. Such a record is required in a locomotive-engine building works. Form 9 shows that 30 engine frames and 60 rails were called for on Order No. 123. It will be seen by referring to the left-hand side that on March 5 four frames were received from the foundry and planed. On March 6 four more frames were received, making a total of eight, and so on, until by March 20 the full allotment had been received. The planing operation on all the frames was completed on March 23, the slotting operation on March 28, drilling on April 2, and on April 11 all of the frames were assembled. On the right-hand side

10

FOUNDRY DAILY PRODUCTION RECORD

Date July 2, 1917 Distribution Sheet for Moulders Time No 3

Order No		Description	Pieces Produced			Cause of Loss	Moulder		Wages			Weights	
Shop	Pattern		Total	Good	Bad		Name	No	Hours	Rate	Amount	Good	Bad
75	16	Bed Frame	10	8	2	Blow Hole	A. Parker	1	10	.70	7.00	800	200

FORM 10. FOUNDRY DAILY PRODUCTION RECORD

of Form 9 the production of rails is shown recorded in a manner similar to that used for frames.

The advantage to be gained from keeping a record of production as above outlined is that such a record furnishes a means for tracing the product through the various operations in the factory. In case the Production Record shows that any parts stop moving, an inquiry can be made at once to ascertain the reason for the delay and steps taken to accelerate the movement of the parts. A record such as that presented in Form 9 is thus seen to form a valuable administrative guide for use in following up and exercising control over production.

The cost sheet for a parts order is operated separately from the Production Record; it provides for summarizing the cost of material, labor, and overhead charged to the individual job number. When the final delivery is made, as shown by the Production Record, the cost accountant is notified of the fact so that he can take the necessary steps to figure the cost of the product. The various operations required to produce magnetos, water meters, and automobiles constitute sort of intermittent processes which are generally controlled by production records.

70. Foundry Daily Production Record.— In specialized industries such as iron and brass foundries production reports are used

as a means of furnishing a complete record of each day's output. The "Foundry Daily Production Record," Form 10, illustrates the method used for reporting the number of pieces produced, the good ones being separated from the bad ones as shown. Provision is made on the form for entering the molder's name, hours, and amount of wages chargeable to the job. Information given on the Production Record is needed by the cost accountant when making a calculation of the cost of producing good castings. In a foundry the loss sustained through bad castings has to be borne by the good castings. This is the reason why the Production Report is designed to show, not only the pieces, but also the weight of the good castings separately from the bad castings. Whenever special forms of production reports are required, an investigation must be made in order to ascertain just what information is needed on the report forms.

The three forms of production reports illustrating the practice followed in reporting production in certain branches of textile, mechanical, and foundry industries are suggestive of methods to be followed in devising forms to meet the requirements in many other industries.

71. **Automatic Counting.**— A record of production to be used as a basis for figuring costs must be accurate. An estimate made by a foreman or a workman's report of what has been produced is not as reliable as a record obtained by some mechanical means. One of the most valuable devices for obtaining an accurate record of factory production is an automatic counter. This counter can be attached to printing presses, looms, punches, and stamping presses — in fact, wherever a wheel turns, and it automatically counts the product as it is being manufactured. This method saves the time and expense of counting the product after it is finished. By this means the management knows what the operatives, and also what the machines, are producing. The counters benefit both the employer and the employee, for, on the one hand, the employer can judge easily from his counter records which men are doing the best work, while, on the other, the operatives realize that if their counters show high production, the foreman must recognize their worth.

In factories where the piecework system of wage payment prevails, the automatic counter is a valuable aid in obtaining records of the number of pieces produced by each operative. Some counters

are made with locks to prevent tampering, while others can be reset instantly. The information shown on the dials of the counter has to be transferred to the production reports for future reference when figuring costs.

72. **Production Orders.**— In typical factories of the job-order class it is usual to exercise control over production by using a specific set of instructions covering each job or contract to be fulfilled. Many expedients have been devised for coördinating the routine of production with cost-keeping requirements, but the starting point in all job-order factories is the production order. In any large plant production orders originate in several ways and are issued for different purposes. Before considering some of the forms that have been devised for use in issuing instructions to the factory regarding work to be done, let us enumerate the classes into which production orders generally fall.

73. **Classification of Production Orders.**— Production orders for merchandise usually originate either from customers' orders or from storeskeeper's requisitions. Special jobs are done in accordance with the requirements of an individual customer; for instance, the dyeing and manufacturing of an ostrich-feather plume to match a piece of dress goods is done on a special order for a customer. The making of an X-ray machine for stock is also done on an order to replenish the stock before it becomes exhausted by shipments to customers.

It frequently happens that after the factory receives a production order, it is necessary for *sub-production orders* to be made out for parts and separate operations. The sales department sends the factory an order for a central office switchboard, and then the factory must make out separate orders for parts not in stock and also for the assembly and installation of the switchboard in the telephone exchange.

The purpose for which any production order is issued should be clearly indicated and a proper classification adhered to, so that the cost incurred in connection with each order may be accurately distributed to the various accounts on the ledger. In all cases the factory output is credited to the manufacturing department at the cost of production. Reference to a few production-order forms used in actual practice will help to make clear just what information is

required on a production order under various operating conditions, our illustrations being drawn from various industries.

74. Production Order for a Printing Factory.— A good illustration of a special order form is the envelope form generally used

Overhead charged by rates

PRODUCTION ORDER No.
FOR DATE
ADDRESS
DATE STARTED PROMISED

PROOFS TO BE SHOWN TO

DESCRIPTION OF ORDER
QUANTITY SIZE NO. OF PAGES

STOCK	USED	RETURNED

CUTTING DEPT.

MACH. NO.	QUANTITY OF STOCK	CUT TO SIZE

RULING DEPT.
MACH. NO. INSTRUCTIONS

COMPOSITION
SET BODY LONG (SHORT) WAY
TITLES STYLE OF TYPE
SUB-TITLES
BODY
REMARKS

PLATES
ELECTROS ZINC HALFTONES
WOOD CUTS COPPER PLATES STEEL ENG.
DATE ORDERED FROM REC'D

PRESS ROOM	PRESS NO.	COPIES	FORM	INK	QUANTITY

BINDING DEPT.
FOLDING MACH. NO. NO. OF SIGNATURES
WIRE STITCHING MACH. NO. HAND SEWED
FORWARDING END PAPERS BOARDS
COVERING MATERIAL AND STYLE OF COVER
FINISHING STAMPING
KIND AND QUANTITY OF GOLD
KIND AND QUANTITY OF COLORS

SHIP TO
VIA
DATE SIGNATURE

FORM 11. PRODUCTION ORDER

by job printers. The face of the envelope contains sufficient space for entering full particulars of what is wanted, as shown in Form 11. It should be the rule to make the instructions regarding the job so complete that an operative never has to look any other place than at the envelope in order to proceed with the work. The orders are

numbered consecutively and each follows its job through the factory. When work on an order has been finished, one or more copies of the order are put in the envelope, after which the envelope is filed according to job number for future reference. By this plan a copy of the work done on any job can be located quickly in case a repeat order is received from a customer. Some concerns operate a cross index to the job tickets by entering the number of each job done for a customer on a card which is filed under the customer's name.

Only one copy of a printing-factory order requires to be made. The order accompanies the paper stock during its progress from the raw-material storeroom through the pressroom and bindery to the shipping room. Paper used is charged to the proper production order number, and all operatives report their time in the composition, pressroom, ruling, binding, and other departments against the order numbers so that the cost of manufacture can be figured. The cost sheet suited for use in a printery has several special features, which will be explained in the next chapter, together with other Cost Ledger forms.

75. Production Order for Shoes.— There are cases where more than one copy of the production order is required to be made out, and, accordingly, reference will be made next to the forms used in a shoe factory, which has this requirement. Salesmen for shoe factories make a practice of sending in the orders which they have taken from customers each season far in advance of the date when shipments are to be made. This allows the factory sufficient time for manufacturing. From the salesmen's orders the production orders illustrated in Forms 12A and 12B are made out for each case of shoes to be manufactured. There are usually five parts to the production order, so that each department in the factory requiring information about the shoes to be produced can have a copy of the order. The order is most economically made out in manifold. The printing on the face of all copies of the order is the same, except for the headings, which read as follows: (1) "Office Copy"; (2) "Cutting Room (Trimmings)"; (3) "Cutting Room (Linings)"; (4) "Sole Leather (Stock Room)"; (5) "Factory Tag."

The fifth or last copy of the production order is printed on tag stock and eyeleted so as to provide for tying to the container which holds the shoes during the manufacturing process. The back of the

SHOE TAG

ORDER NO. DATE
SALESMAN TERMS
CUSTOMER
ADDRESS
STYLE NO. LOT NO.
TO BE DELIVERED
SHIP VIA

NO. OF PAIR	SIZE	NO. OF PAIR	SIZE

SPECIFICATIONS

BALL	WAIST
INSTEP	HEEL
ANKLE	TOP

VAMP PAT	HEEL
TIP "	HEEL CUTTER
QUAR. "	BRASS SLUGGING
STOCK VAMP	TOP PIECE
" TOPS	BOTTOM FINISH
" TIP	" LININGS
BACK STRAP	TOP FACINGS
LININGS	RIBBON LACER
EYELETS	BOW
BUTTONS	SLIDE
BUTTON LAPS	SIZE SYSTEM
PERF. FOX	LABELS
SEWED	FOREPART STAMP
LAST	SHANK STAMP
LENGTH VAMP	CARTON
BOX	STAMP CARTON
COUNTER	GRADE
WIDTH WELT	STYLE
OUTSOLE	PAIRS
INSOLE	DATE
SOLE STITCH	SHIPPED
EDGE	REMARKS

NOTICE
COUNT AND EXAMINE THIS LOT AS ANY SHORTAGE OR DAMAGE WILL BE CHARGED TO THAT PERSON WHO LAST HANDLED IT

DATE LEFT OFFICE

DATE OF LEAVING EACH OF THE FOLLOWING DEPARTMENTS.
CUTTING ROOM
FITTING ROOM
BOTTOMING ROOM
SHIPPING ROOM

CUTTING ROOM

OUTSIDE CUTTER
TRIMMING CUTTER
EXAMINED AND COUNTED

FITTING ROOM

COUNTED BY
SKIVER
BACKSTRAPPER
HEADER
FITTER
TOP CLOSER
TOP STITCHER
VAMPER
PACKED AND COUNTED BY

BOTTOMING ROOM

PULLER OVER	UPPER CLEANER
MCH. LASTER	SEAT WHEELER
HAND "	FINISHER
TACK PULLER	CROWNER
SEWER	SOLE STAMP
SOLE LAYER	HEEL LINER
ROUNDER	LINING CLEANER
STITCHER	IRONER
FUDGE WHEEL	LACE OR BUTTON
2ND LASTER	BOW SEWER
SEAT LASTER	2ND CROWNER
SEAT TRIMMER	TIP FIXER
BOT. SCOURER	STENCIL CART.
NAUMK "	MATING
BOT. STAINER	PACKER

SIGNATURE

FORMS 12A AND 12B. PRODUCTION ORDER FOR SHOES

factory tag is printed as shown in Form 12B. As operatives finish work on a lot of shoes, they write their names on the back of the factory copy in the spaces provided for the purpose. Then, at any time during the process of manufacture, reference to the factory tag shows just which employee performed any particular operation.

The system of manifold production-order forms such as those designed for a shoe factory has a wide range of application. It is safe to say that there are more manifold production-order systems in use than there are single-order systems such as the one described for use in a printery.

Before production orders for shoes can be issued to the factory it is necessary to see that the required lasts are available (the last is the wooden form over which the upper of a shoe is drawn so that it will have the desired shape when attached to the sole-leather parts). In order to control the lasts, it is the practice to operate a special record. This record shows the inventory of lasts on hand according to their style numbers and sizes. As the production orders are put into work, the number of pairs of lasts required for each lot must be deducted from the inventory. After the order-tracing sheets from departments where lasts are taken out of shoes are returned to the office, an entry of the lasts returned and available for production is made on the last record. Production orders should not be issued to the factory unless they can be taken care of from the lasting department onward.

This matter of the record of lasts available for use has been referred to at length because similar conditions are found in many industries other than the shoe industry. Thus, for example, in a straw-hat factory it is necessary to keep a record of hat blocks so that a production order will not be issued to the factory unless the necessary hat blocks are available. In a foundry it is of the utmost importance to see that the patterns and flasks are ready before issuing work orders to the foreman. In highly organized plants it is generally the duty of one particular clerk to see that no work orders are issued to the factory unless the necessary equipment is available.

76. Style Number Index Card.— In some industries it is the practice to produce the finished product by assembling parts which have already been prepared. Under this system of factory management one series of orders is issued to make the parts, and another

series is issued to assemble the parts into the finished article. The production orders are usually typewritten in manifold for the purpose of furnishing a copy to each department requiring information about the goods to be manufactured. Forms used in an ostrich-

13 8

DESCRIPTION SELL. PRICE No. 1948

Black French Plume $48.00 per doz.

QUANTITY	MATERIAL	No.	OPERATIONS	P.W. RATES
1	TOP	1	CLEANING	
1	MIDDLE	2	STRINGING	
1	UNDER	3	DYE HOUSE	
		4	SELECTING	
		5	PREPARING	$ .35
		6	SEWING	.75
		7	STEMMING	.20
		8	CURLING	1.40
		9	BENDING	.15

FORM 13. STYLE NUMBER INDEX

feather factory where plumes are made will be explained to illustrate the operation of a production-order system covering both the production of parts and the assembly of all into finished goods. The system starts with the preparation of the "Style Number Index Card" shown in Form 13, which is made out whenever a new style

is designed. The feather shown in the illustration on the "Index Card" requires for its manufacture three ostrich feathers, which are superimposed one upon the other, and which are known as the top, middle, and under feathers. A record is also made on the index card of whatever piecework rates are established for the operations on the particular style.

77. **Production Orders in an Ostrich-Plume Factory.**— Two series of orders are issued to produce ostrich-feather plumes. The

14

DRESSED GOODS COST SUMMARY

DATE	LOT No.	WEIGHT	PRICE	AMOUNT	JOB No. 1.
SPECIFICATIONS	1	10 LBS	$95.90	$959.00	STRINGS 34
COLOR - BLACK					FEATHERS 1,684

LABOR			BURDEN	COST SUMMARY	
EMP. No.	OPERATION	AMOUNT			
10	CLEANING	$ .94		MATERIAL	$959.00
20	STRINGING	2.59		LABOR	19.53
30	DYE HOUSE	5.00		BURDEN	17.90
32	" "	3.00		TOTAL	$996.43
40	SELECTING	8.00			
	TOTAL LABOR	$19.53	$17.90		

FORM 14. DRESSED GOODS COST SUMMARY

first series is issued for making dressed goods — individual feathers ready for assembly into plumes. The second series of orders is issued for the manufacture of finished plumes from dressed goods.

Orders for Dressed Goods.— Raw ostrich feathers are purchased in lots and have to be dressed before the individual feathers can be assembled and made into the finished plumes. The first step, then, is the issue of a quadruplicate production order for dressed goods, the different copies being designated as follows: "Dressed Goods Cost Summary" (Form 14); "Requisition on Raw Stores" (Form 15); "Dye House Production Order" (Form 16); "Selector's Copy" (Form 17).

The information appearing just below the heading of each form

Shows issue of stock & cost of material

15

REQUISITION ON RAW STORES

Date	Lot No	Weight	Price	Amount	Job No. 1.
Specifications :-	1	10 lbs	$95.90	$959.00	Strings 34
Color Black					Feathers 1684

Form 15. REQUISITION ON RAW STORES

is the same on every copy: 10 lb. from Lot 1, $95.90 per lb., consisting of 1,684 feathers in 34 strings, which are to be dyed black on Job No. 1. On the first, or office, copy the cost of production is figured as shown, the labor and overhead burden being added to the

16

DYE HOUSE PRODUCTION ORDER

Date	Lot No.	Weight	Check No.	Job No. 1
Specifications :-	1	10 lbs	55	Strings 34
Color Black				Feathers 1684

Form 16. DYE HOUSE PRODUCTION ORDER

17

SELECTOR'S COPY

Date	Lot No.	Weight	Selector's Name	Job No. 1.
Specifications :-	1	10 lbs	J. Smith	Strings 34
Color Black				Feathers 1684

Tops			Middles			Unders		
Quantity	Style No.	Price	Quantity	Style No	Price	Quantity	Style No.	Price
15	1012	$.40	332	1630	$.62	8	2284	$.73
99	1115	.42	27	1736	.64	99	3024	.42
62	1218	45	111	1845	.66	36	3130	.50
67	1321	57	74	1948	.69	15	4024	.40
26	1424	.61	104	2060	.70	125	4130	.44
77	1527	.61	18	2172	.81	27	4236	.52 over

Form 17. SELECTOR'S COPY OF PRODUCTION ORDER

material in order to arrive at the cost of dressed goods. The second copy serves as a requisition on raw stores. The third copy is used as the dye-house production order; the number of the brass check which is attached to the strings of feathers while they are being

18

OFFICE COPY

FINISHED GOODS PRODUCTION ORDER

Date — Job Nos. 1-10

Checked by — Specifications: Black French Plume — Style No. 1948 — Quantity 10 Doz. — Stock

Operations	Job Numbers 1	2	3	4	5	6	7	8	9	10	√	Labor	Burden	Cost Summary Item	Amount
5	50	50	50	50	54	54	54	57	58	58	√	$3.50		Material	$232.80
6	62	62	63	63	64	65	62	63	60	60	√	7.50		Supplies	6.00
7	73	71	72	75	75	75	75	75	75	76	√	2.00		Labor	28.50
8	85	85	80	80	81	81	81	82	83	84	√	14.00		Burden	30.04
9	90	90	90	90	90	90	90	90	90	90	√	1.50		Total	$297.34
												$28.50	$30.04	Per Doz.	$29.73

Form 18. OFFICE COPY OF FINISHED GOODS PRODUCTION ORDER

dyed is entered as shown in Form 16. The fourth, or selector's, copy contains columns for entering the results of the selection of the feathers after they are dressed. Thus, out of the total of 1,684 feathers dressed, there were 15 suitable for making into tops for Style 1012, costing $0.40 each, and so on, as shown.

Orders for Finished Goods.— When orders are received for French plumes, or when goods are required for stock, a triplicate finished-goods production order has to be made out, the various copies being

19 FACTORY COPY

FINISHED GOODS PRODUCTION ORDER

DATE — JOB NO. 1.

DATE COMPLETED	SPECIFICATIONS -	STYLE NO. 1948
	Black French Plume	QUANTITY 1 DOZ.
	FOR Stock	STOCK

EMPLOYEE'S SIGNATURE

5 PREPARING	6 SEWING	7 STEMMING	8 CURLING	9 BENDING
Mary Marks	Dora Jones	Lucy Smith	Mary Snow	Anna Shaw

FORM 19. FACTORY COPY OF FINISHED GOODS PRODUCTION ORDER

designated as follows: "Office Copy" (Form 18); "Factory Copy" (Form 19); "Requisition for Dressed Goods" (Form 20).

Ordinarily a dozen feathers constitute a job, and each production-order form is designed to accommodate 10 jobs. The "Office Copy," Form 18, is designed to be used for checking the pieceworkers' time tickets, as well as for figuring the cost of production. There are 10 columns in the lower left-hand side, thus providing for the checking of 10 jobs against the various operations of preparing, sewing, stemming, curling, and bending. The method of checking is to enter the employee's number opposite the proper operation number as shown when a piecework ticket is passed for payment. The amount of the operative's pay can be verified by referring to the "Style Number

Index Card," Form 13. The office copy of the finished goods production order also provides a means of tracing a job through the factory, because a glance at the last operation checked tells how far the work has progressed. When all of the jobs called for on an order have been completed, the cost of material, supplies, labor, and overhead burden are added together for the purpose of obtaining the cost, which is shown to be $29.73 per dozen. The factory copy stays with the goods during the process of manufacture, provision

20

REQUISITION FOR DRESSED GOODS

DATE — JOB NOS. 1-10

DEL. TO OPER. NO.	SPECIFICATIONS:-	STYLE NO. 1948
SIGNATURE	Black French Plume	QUANTITY 10 DOZ.
		STOCK

MATERIAL

QUANTITY	DESCRIPTION	PRICE	AMOUNT
120	1948 Tops	$ .73	$ 87.60
120	1948 Middles	.69	82.80
120	1948 Unders	.52	62.40
			$ 232.80

FORM 20. REQUISITION FOR DRESSED GOODS

being made for entering the names of the operatives doing the different operations. On the third copy a record of the quantity of dressed goods delivered on the order is entered for use in figuring the cost of material used.

The provision made on the office copy of the production order for calculating the cost of manufacture in an ostrich-plume factory illustrates a method frequently employed of combining the cost summary with the order forms. This can be done when the information required for figuring costs does not fill up too much space. The manifold production orders used in an ostrich-plume factory are suggestive of the forms suited to meet the needs of a large number of job-order factories.

78. Parts System for a Machine Shop.— In highly organized machine shops, where the product is composed of a great many standardized parts, the engineering department provides each of the production departments with blueprints and complete specifications of every part or assembly that it may be required to produce. Then when production orders are issued, detailed specifications do not have to be given because reference can be made to the blueprints and specifications already on file. It is necessary that some means be devised for properly identifying the parts, of which there are usually a large number. The method which first suggests itself as a means to the

21

STOCK LIST

NAME CHAMPION WIRE HOLDER No 883

	PIECE	REQ	MATERIAL	NAME		PIECE	REQ	MATERIAL	NAME
A	P 5443	1	STEEL	LONG JAW	C	P 5451	1	STEEL	SPRING HOLDER
A	P 5444	1	"	SHORT JAW	C	P 5452	1	"	POST
A	P 5445	1	"	LEVER	C	P 5453	1	"	STOP
A	P 5446	1	"	LINK	C	P 5447	1	"	LINK
A	P 5447	1	"	LINK					
A	P 5448	1	"	RIVET					
A	P 5449	4		RIVET					
A	P 5473	1	WIRE	SPRING					
A	P 5475	1	STEEL	RIVET					
A	P 5476	1	"	WASHER					
A	P 2431	1	"	SHACKLE					
B	P 5450	1	STEEL	SPRING HOLDER ASSEMBLY					

A. INDIVIDUAL PARTS } NEEDED BY ASSEMBLY FOREMAN
B. PARTIAL ASSEMBLIES }
C. BLANK PARTS ENTERING PARTIAL ASSEMBLIES

ASSEMBLY DRAWING 231

FORM 21. STOCK LIST

end desired is to classify and number all parts used in assemblies. Parts can readily be classified under three heads, as follows:

Class A. The individual parts needed by the assembly foreman
Class B. The partial or sub-assemblies consisting of several Class C parts needed by the assembly foreman
Class C. The parts used for making partial assemblies

79. Stock List.— The method of classifying and numbering parts will readily be understood by referring to the "Stock List," Form 21, sometimes referred to as the "Bill of Material," on which appear the parts required for assembling a wire holder. It will be seen by reference to the left-hand side of the stock list that there are 11

individual parts of Class A and one partial assembly of Class B needed by the assembly foreman. The four parts of Class C entering the partial assembly (P-5450) are shown at the right-hand side of the stock list. The numbers assigned to the various parts or assemblies are used for the purpose of identification.

80. Assembly Drawing.— An "Assembly Drawing," illustrated in Exhibit G, is used to show the relations that different parts of an assembly bear to each other. The engineering department prepares assembly drawings on which the different parts are shown, properly numbered as illustrated in Exhibit G. It will be noticed that the

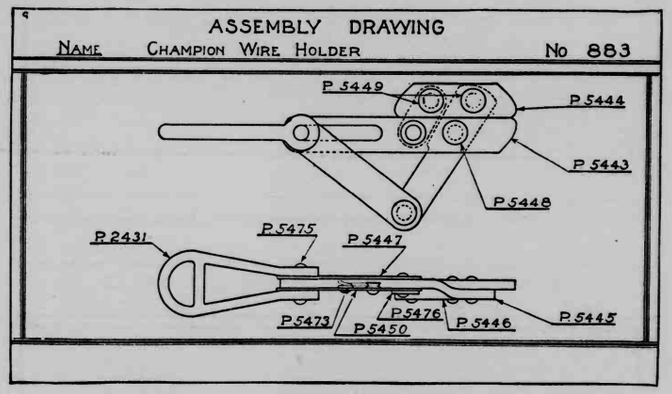


EXHIBIT G. ASSEMBLY DRAWING OF CHAMPION WIRE HOLDER

eleven individual parts and the one partial assembly each appear separately numbered, but that the four parts entering the partial assembly are not numbered, the whole being regarded as a unit. The engineering department also provides an additional drawing for the unit or sub-assembly giving the number of each individual part.

81. Individual Parts Needed by the Assembly Foreman.— A separate drawing which gives the specifications for each individual part needed by the assembly foreman is required for use in connection with the system herewith described; it is illustrated in Exhibit H. It will be noticed that not only the dimensions, but also full stock specifications are given for the rivet, Part 5448. This precaution of providing each foreman with a complete file of draw-

ings for all of the individual parts manufactured renders it unnecessary to give more than the quantity and part numbers when issuing production orders.

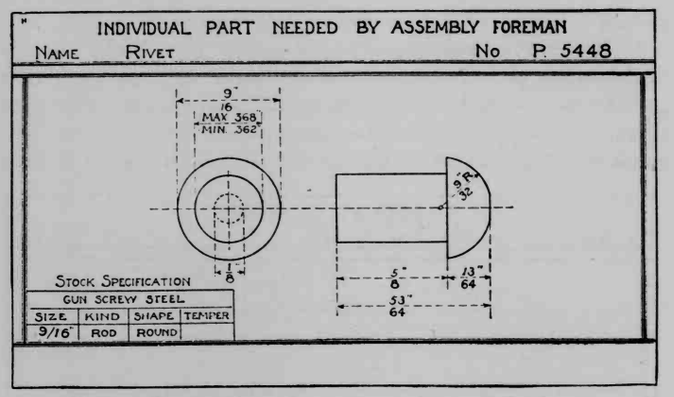


EXHIBIT H. INDIVIDUAL PART NEEDED BY ASSEMBLY FOREMAN

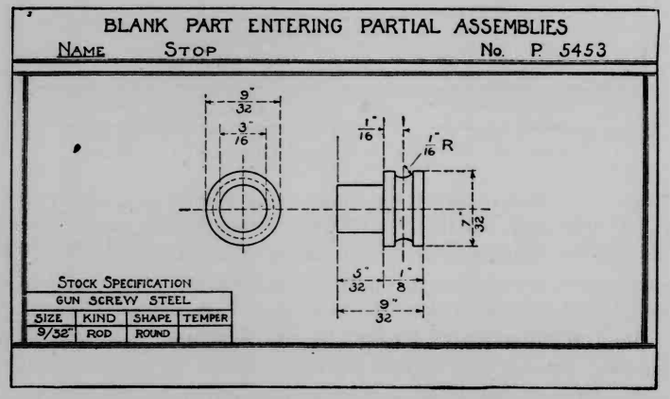


EXHIBIT J. BLANK PART ENTERING PARTIAL ASSEMBLIES

82. Parts Entering Partial Assemblies.— It is also necessary to prepare blueprints giving the dimensions and stock specifications of all parts entering partial assemblies, as shown in Exhibit J.

83. Raw Material Index.— In connection with the preparation of the various drawings giving the dimensions and specifications of the different parts used in assemblies, it is also necessary to prepare a card file which shows the raw material required for 1,000 parts. Reference to the "Raw Material Index," Form 22, shows that

22

RAW MATERIAL INDEX

To Store No. 2 Material per 1000 Parts P 5443

RM No.	Quantity	Description	Deliver to Dep't No
27	350-0	13/16" x 1/4" Cold Drawn Bar Rect. Steel	206

Date 19 Dep't No. 31 per

FORM 22. RAW MATERIAL INDEX

Store No. 2 must deliver 350 lb. of 13/16 in. x 1/4 in. cold-drawn rectangular bar steel to Department 206 in order to produce 1,000 of parts 5443. The raw material is given a R. M. number for the purpose of identification. The storeskeeper is not permitted to issue more material for a production order than the quantity allowed on the "Raw Material Index."

84. Operation Index.— Each department that is required to perform one or more operations on a part is given a card, such as that illustrated in Form 23, on which the operations that must be performed on the part are specified. Operations are numbered, and the departments from which the parts are received, as well as those to which the parts go, are indicated by numbers. The "Operation Index" is referred to when sub-production orders are issued for separate operations. When this is done, the time of operatives is charged directly against part and operation numbers. Then summaries are prepared showing the average labor cost per 1,000 for

each operation on each part. This is the practice in the mechanical industry. The labor on a farm tractor consists in the amount of time spent on each operation in making parts and assembling them. After a cost has been figured, it is generally entered on a card-index form for future reference.

23

OPERATION INDEX

To Dep't No 205 P. 5443

Rec'd from Dep't No	Operation No	Operation	Deliver to Dep't No
206	2	Drill	205
205	3	Burr Holes	206
206	6	Grind Burr	113

Form 23. operation index

85. Square-Turn Farm Tractor.— The mechanical or, as they are sometimes called, the "assembling" industries are so important that another reference will not be out of place. There is a great advantage to the cost accountant in having the product standardized, which is the case when parts are manufactured according to rigid specifications and assembled into the finished unit. Under such conditions there is no doubt about the quantity of material entering into the product, for the reason that the engineers' specifications must be adhered to by the factory. If the cost department is advised regarding the number of units of the product manufactured, it is a simple matter to make a calculation of the material used. An illustration from the automotive industry will make this point clear. The "Square-Turn" farm tractor shown in Exhibit K consists of several hundred parts. About 70 of these parts are made from gray-iron castings which are machined in the shop. Some of the parts are fabricated from bar and sheet stock, and some of the parts are purchased all ready to be assembled. Sub-assemblies are made from parts and put in stock. The erecting foreman builds the tractor with sub-assemblies and such individual parts as are required. Names of the sub-assemblies embodied in the tractor are shown in Exhibit K.

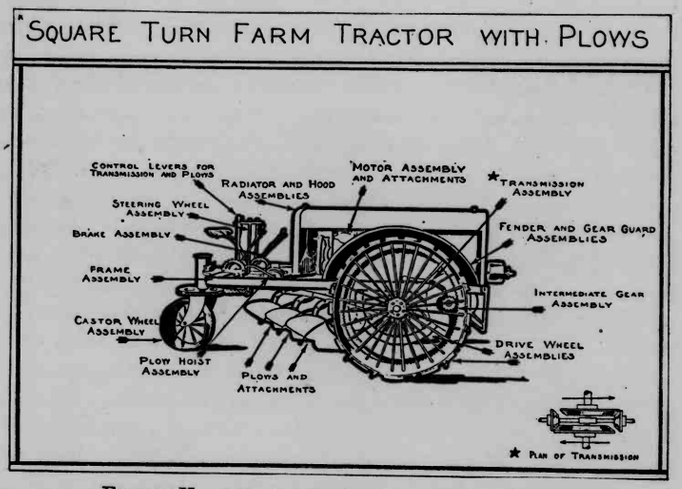


Exhibit K. square turn farm tractor with plows

Under the conditions prevailing in assembling industries the cost department frequently obtains information as to the number of articles purchased and then proceeds to make a calculation of the material used, instead of compiling the information from stores requisitions. The former method is thought to give satisfactory results and is quicker. The material issued to the factory to make parts, the parts used for sub-assemblies, and the sub-assemblies and parts in the finished product must be in the proportion specified by the engineering department. Thus, it is apparent that the variations in cost from period to period are not due to a difference in quantities used but to changes in purchase price.

86. Production System in Assembling Industries.— In assembling industries the production system must provide that the required parts are made sufficiently in advance of the time when they

are needed for assembly so that an accumulation of parts stock will be on hand when required. Because of the intricacies of the product in mechanical industries, it is now quite a common practice to plan all production in advance. The mechanism of controlling production when planned in advance is accomplished by means of a device known as a "planning board." In a large plant several of these boards may be required. The general method of operation is as follows:

The board consists of a number of horizontal strips of metal, containing grooves into which small cubical blocks with half-inch faces can be inserted. These strips are placed one above the other on a frame, and there is a strip to represent each part, partial assembly, or finished article wanted. These metal strips are notched at half-inch intervals, each interval representing one working day. Starting at the right-hand side of the planning board, after all the strips have been erected, the procedure of planning consists in counting back the number of intervals representing the number of working days, to the point at which each part must be started in order to be ready when needed for partial or final assembly. When the point has been determined at which operations must be commenced, a cube containing the symbol of the first part or assembly on its face is inserted in the strip. At the top of the board is a calendar tape which shows the days of the month. It will thus be seen that by looking at the planning board on any date, one obtains a visual picture of just what the factory is required to do that day. On the day indicated by the marker farthest to the left, production must be started on a certain part. From then on, certain production orders must be issued each day, as shown by the markers in the planning-board strips, in order that the finished product may be completed on schedule time.

87. Dispatching Orders.— Under the conditions prevailing in the assembling industries it is essential that the various production orders be prepared and given to the dispatch clerk. He arranges them chronologically according to the dates when work must be started as shown by the planning board, and also according to the schedules of the machines on which the work is to be done. A separate production order is usually issued for each operation on every part, as previously mentioned. When work assigned to a certain machine is finished, the dispatch clerk removes from his file the next order for that machine, and gives it to the operative. It is also necessary for the clerk in charge of the board to post information on the planning board when work on an order is finished. This operation consists in the insertion of a cube carrying the necessary data on its face in the proper strip and under the proper date. Thus, it is seen that the progress of the various parts and assemblies is continually reported. A glance at the planning board shows just what parts are behind schedule.

In mechanical and assembling industries the cost has to be figured for every order issued to the factory and the cost is charged to stock, for it is not until they are requisitioned that orders are charged to the final product. All time spent is reported against job-order or operation numbers so as to facilitate the computation of the cost. The control of production by means of a planning board and the dispatching of production orders to the factory as outlined have a wide range of application.

88. Summary.— There is a very close relation between the production and cost system in either a process or a job-order factory. In the former the quantity of production must be reported so that the cost department can use the figures as a divisor into the total cost of the various processes in order to obtain the cost of each unit of the product. In job-order factories the individual orders must be issued and the cost department notified when work has been completed on each. The highest development of production and cost systems is reached in mechanical and assembling industries, where parts are first manufactured and subsequently assembled into the finished product. The numbering of parts and the preparation of complete specifications of the product furnish the cost department with a valuable check on the calculations. It is often necessary to adapt the production forms to meet the needs of the cost system. Sometimes this is accomplished by making manifold production orders, with one copy designed to be used for the cost calculation. When some such procedure does not seem to be convenient, the cost forms have to be operated entirely separate from production forms. Whenever it happens that several departments must work on parts of an order simultaneously so as to have their work ready for assembly at a particular time, it is necessary to give each one a copy of the order.

Questions on Chapter VI

1. How is production ordinarily controlled in continuous-process plants? Give an example.
2. How is production usually controlled in job-order factories? Give an example.
3. How are job orders frequently classified?
4. What is meant by a manifold system of production orders? What are the various copies used for? Give an example.
5. What kind of a production system is best suited to meet the needs of large machine shops where parts are first manufactured and subsequently assembled into the completed article? How is it operated?
6. What is meant by pre-planning work? In large assembling industries how is production controlled?
7. What advantage is it to the cost department to have the parts numbered and the product standardized?
8. What mechanical aid can you suggest as an aid in counting the number of pieces produced in an operation?
9. What is a good production system for a job-printing plant; a foundry; an ostrich-plume factory; an automobile factory?
10. What is the difference between an individual part and a partial assembly?
11. Suggest a good plan for measuring the productive efficiency of a shoe factory occupying a three-story T-shaped building. The part of the building corresponding to the top of the T is 50′x200′, and the other part is 75′x300′. Shoe manufacturers figure that one pair of shoes should be produced daily for every 10 sq. ft. of floor space.
12. What would be a good method for controlling production in the Webb press department of a job printery, the theoretical production of the presses being 3,600 impressions per hour running time?

CHAPTER VII

COST SUMMARY FORMS

89. Cost Sheets.— Where a study of conditions shows that it is impracticable to combine the cost summary with the office copy of the production order, separate forms must be used. The usual practice in continuous-process factories is to prepare a detailed calculation of cost on a specially designed form at the end of each accounting period, as a week or a month. In a linseed-oil plant the cost calculation shows the quantity of linseed consumed, together with the output of oil and linseed cake. The calculation shows the cost of linseed and the labor and expense per bushel of converting it into raw oil. If oil is refined, the cost of the refining process per gallon is also shown.

In a job-order factory separate cost forms are frequently found in use. The operation of these forms usually consists in making a summary on them of the material requisitions and time tickets charged to the job numbers. Overhead expense is then added according to some appropriate principle of distribution. The main point of difference between one job-order cost calculation and another is the method followed in distributing overhead expense.

Although rulings and titles on cost sheets in various plants differ because the establishments themselves differ in operation and organization, nevertheless the underlying principles are the same. A place must always be provided for recording the details of each of the elements of cost. The extent to which the accountant must provide for entering details under each element of manufacturing costs depends, of course, upon the nature of the industry. A white-lead manufacturing company needs but a few forms, whereas a plant making magnetos needs a variety of forms. To illustrate some typical forms used in figuring the cost of production under a variety of conditions reference will be made to cost sheets used in the shoe, printing, and mechanical industries. The forms are suggestive of what one may expect to find in other industrial enterprises.

90. Cost Sheet for Shoes.— In the boot and shoe industry it is the practice to prepare an analysis of the cost of each style of shoe on a cost sheet such as is shown in Form 24. The cost sheet is designed for figuring the cost of three different styles. On the left-

24 COST SHEET

	NO. DESCRIPT	TOTAL	NO DESCRIPT	TOTAL	NO. DESCRIPT	TOTAL
VAMP						
TOP						
TIP						
FOXING						
TONGUE						
GORE						
VAMP DOUBLER						
TOP DOUBLER						
TIP DOUBLER						
OUTSIDE FAC'G.						
LACE STAY						
BUTTON PC						
OUTSIDE STAY						
LINING						
QUAR LINING						
BLU VAMP STAY						
HOOK STAY						
BUT PC. STAY						
HEEL STAY						
EYELET FACING						
HEEL PAD						
TOP FACING						
TOP PIECE						
TOTAL UPPER						
OUTER SOLE						
INNER SOLE						
TAP						
WELT						
COUNTER						
HEEL						
TOPLIFT						
SHANK AND FILL						
TOTAL BOT						
BUTTONS						
EYELETS						
HOOKS						
LACES						
BOX TOE						
STRAP						
BOX AND CART.						
TOT. MISC MAT						
TOTAL MAT.						
LESS %						
NET MATERIAL						
ROYALTY						
CUTTING LAB						
STITCH'G "						
STOCK FIT "						
LASTING "						
MAKING "						
FINISHING "						
DRESS PACK "						
TOT. LABOR						
PLUS FOUHEN						
MANUF'G COST						
SELL'G EXP						
DISC'T GIVEN						
TOT. COST						

FORM 24. COST SHEET FOR SHOES

hand side all of the items used in making a Goodyear welt shoe are listed. This makes it an easy matter to fill in the cost figures for different styles and also prevents any item from being overlooked.

Upper Leather.— Material in a shoe is classified under three general heads, known as upper leather, bottom leather, and miscellaneous material. Upper-leather parts are cut, for the most part, from calf

skins, although skins of other animals are frequently used. It will be observed that on Form 24 provision is made for entering the cost of all pieces in an upper, of which there are 23, beginning with the vamp and ending with the top piece.

Bottom Leather.— Next in order come the pieces of bottom leather which are cut from sole leather. Provision is made on the cost sheet for entering the cost of each piece, as shown.

Miscellaneous Material.— Buttons, eyelets, laces, boxes and so on are also entered, in order to find the cost of miscellaneous material, as shown.

Discount on Leather.— In the shoe industry the discounts on leather are very heavy, and therefore it is sometimes the practice to take them into account and figure the leather at the net price when making the calculation of the cost of production.

Royalty.— It is the general practice in the shoe industry to lease machinery on a royalty basis, and consequently provision is made for entering the amount of royalty on the cost sheet.

Labor.—Because piecework prevails to quite an extent in the shoe industry, little difficulty is encountered in figuring the labor cost. The cost sheet provides for showing the amount of the labor cost by departments, of which there are six.

Manufacturing Cost.— To the sum of the material, royalty, and labor must be added the factory overhead, as shown in Form 24, in order to arrive at the manufacturing cost. This is the figure at which the shoes are credited to the factory when finished.

Total Cost.— The selling expense must be added to the cost of manufacture in order to arrive at the cost to make and sell or the total cost, as it is called. Profit is added to the total cost to establish the selling price. The producer, of course, will make the price as much in excess of the cost as the market demand and conditions of competition will permit.

The cost sheet used by shoe manufacturers as a basis for fixing the lowest possible selling prices is also a valuable administrative guide because it enables a comparison to be made between costs actual and estimated. Any discrepancies can then be investigated and steps taken to stop leaks which might otherwise escape notice.

91. Individual Order Cost Sheet.— The cost sheet used by a printer for figuring job costs is shown in Form 25. Under each de-

partment heading provision is made for entering the hours spent on the job. This is a necessary feature because the cost system used by printers requires that the time spent on a job in each department be extended at an hourly rate, in order to arrive at the cost of labor

25

INDIVIDUAL ORDER COST

For			Job No											
			Date Promised											
Date Billed			Quantity				Folio							
Items			Cutting						Ruling					
	Cost	Sell Price	Employee	Sym	Hours	Rate	Amount		Employee	Sym	Hours	Rate	Amount	
Paper														
Ink														
Burden @														
Cutting			Composition						Job Presswork					
Ruling			Employee	Sym	Hours	Rate	Amount		Press No	Sym	Hours	Rate	Amount	
Composition														
Job Press														
Cyl. Press														
Bindery														
Outside			Cylinder Presswork						Bindery					
			Press No	Sym	Hours	Rate	Amount		Employee	Sym	Quant	Rate	Amount	
Total														
Selling														
Grand Total														

FORM 25. INDIVIDUAL ORDER COST SHEET

and overhead chargeable to the job. At the left-hand side provision is made for entering the cost of paper and ink, together with burden on the stock used, in order to arrive at the total cost of material. Below the material items the departmental costs are entered for cutting, ruling, composition, presswork, binding, and outside work. The cost of material added to the departmental costs gives the total cost of manufacture. To this the selling expense must be added in order to arrive at the total cost, as shown.

One special feature of the "Individual Order Cost Sheet" is the column headed "Selling Price" next to the cost column. The purpose of these two columns is to provide a means for comparing the original estimate made by the printer when bidding on the customer's order with the actual cost after the job has been finished. Cost sheets such as Form 25 are suitable for use in a large number of industries where work is estimated in advance and where a comparison is wanted between the estimate and the actual cost after the job has been finished.

92. Cost Summary Form for Separate Burden Application.— The details of the formulae used in figuring costs in any particular industry determine to a large extent the design of the cost sheet. Reference to Form 26 shows the Cost Summary used in a factory

26

COST SUMMARY No._____

Description_____ Date _____

Departments	Labor	Burden on Labor	Material	Burden on Mat'l	Total	Remarks

FORM 26. COST SUMMARY FORM FOR SEPARATE BURDEN APPLICATION

where the burden is applied separately to labor and material. Provision is made for the use of a different rate in each department if desired. This form, with slight modifications, has a wide range of application in the mechanical and allied industries.

93. Cost Summary Form for Machine Shops.— Another variation in the manner of designing cost summaries is shown in Form 27. It will be seen that each operation is listed and that columns are provided for hours as well as for the amount of labor. The reason for this is that information about the number of hours spent on each operation is needed when the shop expense is apportioned to the job. At the right, provision is made for recapitulating the cost of the job. This form is illustrative of a great many of the cost sheets used in machine shops.

94. Cost Record.— It is frequently desirable to keep a "Cost Record," Form 28, for the purpose of making a statistical summary of the cost of producing the same style of article on different orders. By this means it is possible to see at a glance whether or not the cost

Ord No.	List No.	Quantity	Started	Finished	Name of Part

Material				
Operation	Hours	Amount	Shop Expense	Recapitulation
Turret Machine				Material
Engine Lathe				Labor
Grinders				Shop Expense
Polishing				Total
Milling				No. of Pcs.
Planing				Cost per Pc
Blacksmith				Remarks
Drilling				
Assembling				
Premium				
Other Work				
Total				

Form 27. Cost summary form for machine shops

of manufacturing on any order is higher than on previous orders. If it is, the original cost sheets can be compared to see in what detail the cost varies. The cost record is also used as an index which can be referred to in order to obtain the cost of manufacture for any style which has been made at any previous time in the shop. This is a much more convenient plan than to have to refer to the original cost

28 **COST RECORD**

Style No.				Style No.			
Date	Ord. No.	Quant. Made	Cost	Date	Ord. No.	Quant. Made	Cost

Form 28. Cost record

sheets. Ordinarily the cost figures for a particular style can be condensed on one cost record form for a considerable period. In estimating on new work the cost record is a useful guide because the cost of manufacturing any new style will in all probability be about the same as that of producing a similar style in the past.

95. Special Cases.— Nearly every factory presents a special case for study. However, with the suggestions contained in the forms presented in this chapter the cost accountant should not have any difficulty in designing the necessary cost summary sheets to meet the needs of any case. A production system is not complete unless provisión is made for making a summary of the cost of the product. One of the principal benefits to be derived from the operation of a cost system is obtained by making a comparison of actual costs with estimated costs. A contract for the ornamental bronze work in a bank may be in process a year, and unless the actual cost is compared department by department with the original estimate, leaks may occur and excessive costs be incurred without the matter being brought to light.

Questions on Chapter VII

1. What is the purpose of cost-summary sheets? Give an example of an industry where cost sheets are used.
2. How is a cost sheet used in the boot and shoe industry?
3. How is a cost sheet used in a printing factory?
4. Devise a cost sheet to meet the needs of some factory with which you are familiar.
5. What advantage is gained by comparing actual with estimated costs? Give an example.
6. Devise a cost sheet to be used for estimating the cost of machine-made millinery. Several kinds of materials are used, such as velvet, silk, buckram, and trimmings. The operations consist of cutting, sewing, and trimming.

PART III
MATERIAL COSTS

CHAPTER VIII

INTRODUCTION TO MATERIAL COSTS

96. Cost of Material.— The nature of the system required to obtain the cost of material used in making a unit of the product varies with every industry. In general, however, the problem may be reduced to that of finding, on the one hand, the quantity of material used to produce a unit of the product, and, on the other, the unit cost of the material put into the product. When one knows the quantity of and also the price paid for the material used, it is an easy matter to calculate the total money expended on *the first element of cost.* The difficulties encountered in connection with the calculation of material costs have to do largely with the variation from time to time in the quantity of material used for an article and also with the changes in the prices paid vendors for materials purchased. The ensuing eight chapters are devoted to an explanation of the methods followed in exercising control over material costs.

97. Material Cost Calculations.— If the material used in making the product is extracted from the earth, as is the case in a quarry, mine, clay pit, or other extractive industry, no money is paid to outside vendors for the raw material used.

The material cost is represented by the depletion of the source of supply, as it is worked, and in the records of the concern the amount may appear as royalties paid to the owners of the land on some time or quantity basis, or as rents paid. When the operator himself owns the land, he must establish some depletion rate that will meet the requirements of the technical nature of his enterprise and bear a proper relation to the rate of exhaustion of his total supply of material. In any event there should appear on his books an amount to represent the cost of the material.

In mills using the products of the extractive industries, such as ore, or clay, in the metallurgical and clay-products enterprises, it is necessary to purchase the raw material used from outside sources.

Some textile mills buy fibres for use in making cotton, woolen, silk, and linen goods, and they sell their products to other plants which in turn perform various finishing operations on the material before selling the final product to the consumer. Thus, as we have already indicated, the product of one enterprise may become the raw material of another. Whenever the raw material used in a plant is purchased from outside sources, its cost is definitely shown on the vendor's invoice which is sent with the shipment. Incoming freight charges are frequently added to the price paid the vendor in order to arrive at the total cost of material. The cost of a block of Carrara marble delivered in Long Island City is equal to the amount paid the quarryman in Carrara, Italy, plus ocean freight and lighterage. The amount entered for the raw-material cost in any cost calculation should be the same as the amount paid, including inward freight if paid, for the lot of material taken.

The next matter for consideration is the plan to be followed in ascertaining the quantity of material required to produce a unit of product. The simplest case is that in which one large unit is being produced, such as a battleship or a building. In a shipbuilding yard the purchases of raw material for ships can be segregated easily for individual ships, and the element of material cost on each job thus obtained. However, the usual practice in plants buying material is to purchase fairly large quantities to be kept in stores and issued to the manufacturing departments from time to time as needed. Under such operating conditions it is necessary to provide some means of obtaining a record of the quantity of material used during each period, divided according to processes or individual jobs. When a record of the quantity of material used and the price paid for it has been obtained, the cost of material chargeable to any process or job can be calculated readily.

98. Loss Due to Waste Material.— Frequently material used in manufacturing a product is subject to losses and waste while undergoing the process of manufacture. The loss due to waste made in cutting stock to the proper sizes in the wood-working, mechanical, and needle industries must be absorbed in the cost calculation of the material actually entering into the product.

99. Means for Controlling Stores.— The usual means provided for exercising control over stores consists in opening an account with

each item of stock in the Raw Material Stores Ledger (Form 1). In a cotton mill bales of cotton as received are tallied by the receiver of goods, who keeps a chronological record of all material received at the mill. This record of goods is used as a means of checking the quantities appearing on the vendor's invoice covering the shipment. The cotton, which may be uplands, middling-grade, or 1-⅛ in.-staple, is entered on the received side of the Stores Ledger card bearing the proper description.

Bales of cotton are opened daily and put into process in the mill. The storeskeeper keeps a record of the number of bales opened and the lots from which they were taken. This record furnishes the necessary information for making an entry on the issued side of the Stores Ledger (Form 1). The ledger card shows the price of the cotton issued, and so an extension can be made to obtain the cost of cotton used.

By deducting the cotton issued from the sum of the initial inventory and subsequent purchases, the *balance on hand* can be determined and entered in the columns provided for the purpose on Form 1. Thus the Raw Material Stores Ledger cards show at any time what the inventory will figure if a count of stock (physical inventory) is taken and the necessary extensions and additions made. One of the most important features of a modern system of stores accounting is the provision, not only for arriving at the cost of material used, but also for ascertaining the inventory without taking stock. The purpose of taking a physical inventory is that of verifying the balances shown on the accounts kept with material.

100. Purchasing System.— The routine connected with manufacturing or trading activities may be considered to begin with the purchase of the necessary material with which to commence operations. There is a close relationship between cost records and the financial books, and one of the points at which the two sets of records interlock is in the purchase of material and the settlement of vendors' claims. In fact, it is generally difficult to tell exactly where the work of the cost accountant ends and that of the general bookkeeper begins. In order that no step may be omitted in our outline of the procedure followed in record-keeping, a detailed description of a complete purchasing and voucher system will be presented in the next chapter.

Questions on Chapter VIII

1. What are some of the difficulties involved in calculating the cost of material used in each unit of the product?
2. What is the usual source of information regarding the price paid for material?
3. How can one ascertain the quantity of material used in making the product?
4. What effect does the making of waste during manufacturing operations have on the cost of the material used?
5. What means are usually employed for exercising control over stores?
6. How would a Raw Material Stores Ledger be operated in a cotton mill?
7. How can the value of the stock on hand be determined without taking a physical inventory?
8. What relation does the purchasing system bear to the cost system?
9. If it takes 2 oz. of shellac to make one 10-inch phonograph record, how much does an advance of $0.10 per pound in the price of shellac add to the cost of a 10-inch record?
10. What does newsprint paper at $0.088 per pound cost in a 20-page daily paper if it takes 130 lb. of paper to produce 1,000 newspapers on an eight-page basis?
11. What is the cost of material required to make a pound of cotton yarn if raw cotton costing $0.30 per pound loses 10 per cent while being made into yarn?
12. What is the cost of fur costing $4.50 per pound in a man's soft hat weighing 4 oz. if 18 oz. of fur are required to produce 16 oz. of hate?

CHAPTER IX

PURCHASING AND VOUCHER SYSTEM

101. Purchasing Agent.— In making a preliminary survey of conditions which exist in a plant prior to the introduction of a modern cost-accounting system, one of the initial subjects of investigation is the routine followed in connection with the purchasing, receiving, and paying for material. The cycle of manufacturing or trading operations may be said to begin with the purchase of material and the vouchering of the vendor's invoices. In this connection the points of special interest to the cost accountant are the provision for distributing purchases to the proper cost accounts, and the provision for furnishing evidence as to the receipt of goods. In every factory or trading enterprise it is necessary that someone act in the capacity of purchasing agent and that some system be adopted for handling the purchases and liquidating them. The buyer requires certain records so that he can do his work intelligently, and the accounting department also requires certain reports and information in order that the proper entries can be made on the books for all goods purchased. From the time that a purchase order is issued until the time that the vendor is paid, a number of transactions take place, for each of which proper records must be provided, as will be explained in this chapter. In extractive industries the main element of material entering into the product is dug from the earth, and so the efforts of the purchasing agent are devoted to securing the supplies and equipment needed for operations.

102. Purchase Specifications.— There are, in general, three ways in which purchases may be made. The first is to order an article by trade name or description from some vendor on the theory that, having been satisfactory for a particular purpose in the past, the article will prove so in the future. The second method is to obtain bids and samples and to place the order after an examination of the samples and a comparison of the prices. The third method is to buy

on specifications with or without competitive bids. Specifications frequently contain clauses which require that tests be made to insure compliance with the requirements. It is obvious that, whenever possible, it is by far the best plan to purchase in accordance with standard specifications, for then there can be little doubt as to just what it is intended to purchase. It is customary for the engineering department, when such exists in an establishment, to prepare the necessary specifications regarding the material required for the product.

The standard specifications appearing in the supply lists of the United States Government show how specifications should be set up. A good example is found in the specifications for map paper used by the Weather Bureau. It reads as follows:

Class 1. Stationery.

Item No.	ARTICLE	Price	Unit	Time of Delivery	Contractor
1356	Paper, map; Weather Bureau; 21½ by 28 inches; 50 pounds; minimum order 1,250 pounds; on specifications ..... STANDARD SAMPLE SPECIFICATION WEIGHT.— 25 by 40, 500; 82-pound basis (21½ by 28—50). THICKNESS.— Shall be not more than 0.0055 inch. STRENGTH.— Shall be not less than 25 points. STOCK.— Shall be not less than 50 per cent rag; the remainder may be bleached chemical wood free from unbleached or ground wood pulp. ASH.— Shall not exceed 3 per cent. SIZING.— Total rosin shall not exceed 2 per cent. COLOR, FINISH, AND FORMATION.— Must conform to standard samples. PACKING.— Put up in bundles of 1 ream and suitably cased.	.1045	pound..	35	X. Y. Z. Company

From the foregoing sample specification it is readily seen how specifications can be prepared for a standard article. The method followed in making up the specification for map paper is suggestive of the plan to be followed in making up other specifications.

103. Purchasing Records.— In order that the purchasing agent of a large establishment may do his work under the most favorable conditions, he should be relieved of all clerical details. This means

that a system of records must be installed to furnish the purchasing agent with all the information he may require at any time, regarding delivery dates, prices, discounts, f. o. b. points, and so on. With the aid of modern devices information can be made readily available that will enable the purchasing to be done in the most efficient manner. Standard forms and methods generally used in connection with the work of purchasing will be explained in some detail to give the reader a clear idea of their effective use.

104. Quotation Record.— The first step in the introduction of a modern purchasing system is to install a "Quotation Record," Form

29 QUOTATION RECORD

ARTICLE Gauges - Steam CARD No. 2

DATE	PURCHASE ORD. NO.	NAME AND ADDRESS	QUANTITY	PRICE AND TERMS LIST	DISCT.	NET	EXPRESS OR FREIGHT	NET VALUE
1917 Jan. 2	10	Aberfoyle Mfg. Co.	10	$5.00	25%	$3.75		
" 10		Lord & Nagle		5.00	33⅓	$3.34		

FORM 29. QUOTATION RECORD

29. A separate card is required for each article on which a quotation is received. At the top of the card a commercial description of the article is written, and in the columns below provision is made for the details of the quotation. Prices obtained by means other than by regular quotations should be entered upon the Quotation Record cards, so that all quotations are recorded in a uniform manner and filed alphabetically. Obviously, the purpose of the form is to show, at a glance, with what various vendors business may be done and which furnish the lowest quotations.

105. Vendors' Record.— The "Vendors' Record," Form 30, is used to show the various articles that can be supplied by a vendor.

At the top of the card the vendor's name and address are written, together with the vendor's catalogue file number. The general information contained in vendors' catalogues, discount sheets, and so on is abstracted and summarized on the Vendors' Record.

30

NAME *Aberfoyle Mfg. Co.* FILE No. *10*

ADDRESS *New York.*

ITEM	UNIT	LIST	DISC'T.	NET	TERMS
Gauges-Steam	*ea.*	*$5.00*	*25 %*	*$3.75*	*2% 10 days 30 days net*
" -Water	*"*	*6.00*	*"*	*4.50*	*do*
Pumps-Oil	*"*	*50.00*	*"*	*37.50*	*do*
Separators-Oil	*"*	*100.00*	*"*	*75.00*	*do*
Grease Cups	*"*	*3.00*	*10 %*	*2.70*	*do*
Whistles	*"*	*4.00*	*"*	*3.60*	*do*

FORM 30. VENDORS' RECORD

106. Catalogues and Discount Sheets.— It is necessary to give the purchasing agent ready and accurate access to catalogues and discount sheets. The best method to follow is to index catalogues and discount sheets, both by firm name and by subject, so as to render them available when wanted. This system requires both an article and a vendor card for catalogue indexing. As each article or discount sheet is received, it is numbered with the number assigned the vendor, and index cards are then made out. Small catalogues and discount sheets are filed vertically in folders in correspondence filing cabinets. The catalogues that are too large to be filed in vertical files are indexed like the others but are placed in bookcases or on shelves. By indexing catalogues and discount sheets as explained, instant reference is obtained, not only to all catalogues and discount sheets of a given firm, but also to all those of a given article.

107. Requisition on Purchasing Agent.— Requests for the purchase of articles should be made by using a "Requisition on Purchasing Agent," Form 31. Full particulars regarding the articles

wanted should be stated on the requisition. In all cases verbal orders ought to be ignored and purchases made only upon a written request. The form shown illustrates how a requisition on the purchasing agent for a barrel of benzine is filled out.

31

REQUISITION ON PURCHASING AGENT

PUR. ORD. No. *75* REQ. No. *510*

TO *Purchasing* DEP'T. DATE *Jan. 15,* 19

PLEASE ORDER THE FOLLOWING MATERIAL FROM *Standard Oil Co.*

TO BE DELIVERED TO *Store* FOR *Stock* DEP'T. FOR *J. W.* ORD. No.

QUANTITY	DESCRIPTION	REMARKS
1 Bbl.	*50 gal. Benzine*	

CLASSIFICATION *010* APPROVED *A. Burt* SIGNED *J. Bennet*

FORM 31. REQUISITION ON PURCHASING AGENT

108. Purchase Order.— The purchasing agent of a factory should be supplied with manifold order blanks or "Purchase Orders" similar to Form 32. The vendor's copy of the purchase order may well be designed to fit an open-face envelope so as to save writing the vendor's name and address a second time. A short carbon can be used in making the duplicate copy to prevent the quantity from appearing on the sheet sent to the receiver of goods. The triplicate or office copy can be on heavy stock in order to facilitate filing, and the back of it can be designed for use as an order record, partial deliveries, promises of shipment, and so one, being entered thereon. The front side of the office copy of a purchase order can be printed with a row of numbers running from 1 to 31 across the top representing the days of the month, to be used in connection with a set of signals for following up shipments. All purchase orders should originate in the purchasing department.

In case material is required for replenishing stock, it is only nec-

essary to place a reorder for the quantity required to bring the stock up to the maximum limit established for the article. If the material is special, to be used only on a particular order, the quantity called for by the order is the determining factor. It is the function of the purchasing agent to buy such quantities of materials as the factory needs to enable it to produce the product and to obtain the material at the lowest possible price for the quality required. It is also the

32

PURCHASE ORDER

THE A. B. Co.
BROCKTON, MASS.

MARK INVOICE / PURCHASE } No. 11514

DATE Jan. 10 19:

Messrs. Standard Oil Co.
ADDRESS New York

TERMS { TRADE 2% 10 days / CASH

SHIP VIA:- Truck WHEN SHIP Soon as possible F. O. B. New York

1 - Bbl. 50 gals. Benzine @ 20¢	$10.00

THE A. B. CO.
PER. A. R. Frank

FORM 32. PURCHASE ORDER

function of the purchasing agent's office to follow up deliveries of materials ordered to see that material is provided promptly for every necessary purpose.

In factories run according to the efficiency plan of management, where everything is standardized, it is quite customary to fix the time within which the purchasing agent must secure material for the factory. Thus, if it takes a month for the purchasing department to secure bids, place the order, receive the material and have it inspected, the shop or the head of the planning department must allow that amount of time when placing the requisition for purchase. It is then the duty of the purchasing department to see that delivery is made within the month. Usually the purchasing agent uses a reg-

ular follow-up system, which provides for keeping in touch with each order until the goods are received from the vendor.

109. Petty-Cash Voucher.— Small purchases are most conveniently handled by providing a petty-cash fund from which payments can be made. It is necessary to obtain a receipt on a "Petty-Cash Voucher," Form 33, for all disbursements made from this fund. These receipt vouchers are counted as cash until the fund requires

33

DATE Jan. 2, 1918 PETTY CASH VOUCHER No. 7

RECEIVED FROM THE A. B. Co.

FOR Express

$	CENTS
1	10

SIGN Adams Express Co., per. B. James.

CHARGE Express

APPROVED C. B. Fox.

FORM 33. PETTY CASH VOUCHER

replenishing, at which time they are summarized and a check drawn for the amount necessary to replenish the petty-cash drawer. In this manner petty-cash vouchers are liquidated just as any vendor's invoice. The petty-cash vouchers are stamped "paid" and filed in the paid-bills file.

110. Voucher Stamp.— As evidence that cash is properly disbursed to settle claims for goods purchased, approved vouchers must be submitted. The invoice itself is often so stamped that it can be approved, thus becoming a voucher. When vendors' invoices are received, they are stamped with the "Voucher Stamp," Form 34, which provides for checking the various items on the invoice. When the persons having knowledge of the facts attach their signatures to the invoice in the spaces provided on the voucher-stamp, the invoice becomes a voucher. Vendors are instructed to put the purchase or-

der number on all invoices in order that the voucher clerk may know just what purchases an invoice covers. On the voucher stamp recommended (Form 34) a place is provided at the top for entering the number of the purchase order authorizing the purchase covered by the voucher. Invoices are checked in the purchasing department as to prices, terms, and f. o. b. points. One of the safeguards employed is to withhold from the receiver of goods the exact quantity ordered. This places on the receiving clerk the responsibility to ac-

34

VOUCHER STAMP

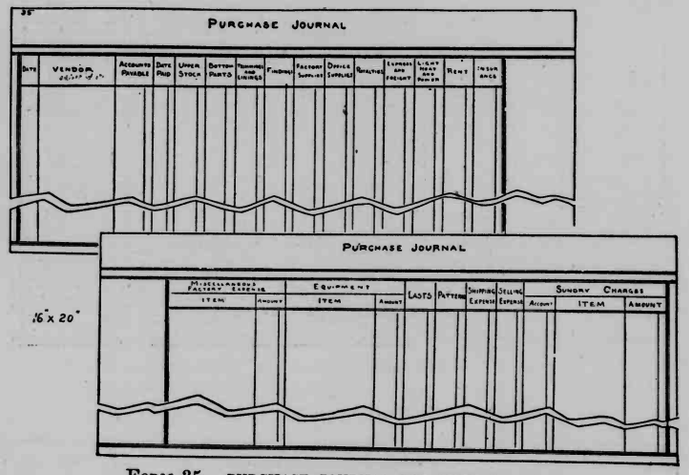
P.O.No.	INV. NO.
DATE REC'D.	PREV. NO.
PRICE AND TERMS - EXT. OK.	VEND. NO.
QUANTITY O.K.	CHARGE
APPROVED	CHARGE
DATE PAID	FREIGHT

FORM 34. VOUCHER STAMP

tually count, weigh, or measure the goods delivered by a vendor. The report of the receiver of goods is made on the duplicate copy of the purchase order from which the quantity ordered was omitted. From this report is obtained the information whether the quantity received is correct. All vouchers are numbered by means of a numbering machine as soon as fully approved for payment.

111. **Purchase Journal.**— It is quite customary to use a columnar form of purchase journal for the purpose of distributing the vendor's invoices that have been vouchered for payment. The names of the accounts in the distribution column headings correspond with the names of General Ledger accounts to which purchases are to be charged. The names of the accounts to be charged depend largely upon the factory, because each industry has account classifications

peculiar to it. The Purchase Journal used in a shoe factory is illustrated in Form 35, and that used in a worsted mill in Form 36. At the end of each month the columns of the Purchase Journal are footed and postings made directly to the General Ledger. Thus it is seen that the Purchase Journal is a book of original entry. A "date-

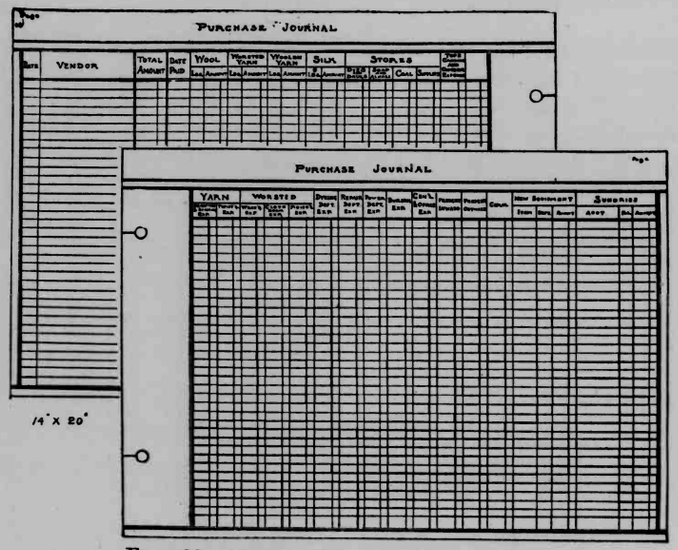


FORM 35. PURCHASE JOURNAL FOR SHOE FACTORY

paid" column is a desirable feature of a Purchase Journal, so that when the settlement of invoices has been made and the dates entered, the open items represent unpaid bills. The total of these unpaid invoices at the end of an accounting period should agree with the balance to the accounts payable controlling account in the General Ledger.

112. **Charge-Back Invoice.**— All goods returned to a vendor are entered on the "Charge-Back Invoice," Form 37. The entry in the Purchase Journal (Forms 35 and 36) for charge-back invoices is the same as the vendors' invoices, except that red ink is used. In computing the charge to any account the red figures are deducted from the black to obtain the net amount of the charge.

113. **Voucher File.**— All unpaid vouchers should be filed in vendors' folders arranged alphabetically. Then, if any one desires to



FORM 36. PURCHASE JOURNAL FOR WORSTED MILL

39

CHARGE BACK INVOICE No. 211

VENDOR NO.

PLEASE CREDIT OUR ACCOUNT ACCORDING TO THIS INVOICE

THE A. B. CO. NEW YORK

TO Standard Oil Co., New York. Feb 2,

QUANTITY	UNIT	ITEM	PRICE	AMOUNT
50	Gal.	Benzine	$.20	$10.00

THE A. B. CO.

FORM 37. CHARGE BACK INVOICE

38

The National Bank — NEW YORK Jan. 22 CHECK No. 7

PAY TO THE ORDER OF $ 131 30

Standard Oil Co.

New York — One hundred Thirty One DOLLARS 30/100

Jan 12, 1917	# 1	$ 10.00
" 12, 1917	7	25.00
" 12, 1917	22	100.00
		135.00 less 2% $131.30

ENDORSEMENT HEREOF ACKNOWLEDGES PAYMENT OF THE ABOVE. NO OTHER RECEIPT REQUIRED.

VOUCHER No. 1/1

THE A. B. Co.

A. B. Thomas TREAS.

FORM 38. VOUCHER CHECK

39

PAY TO Russel & Erwin Mfg. Co. New York DATE Jan. 31, 1917 No. 1

$ 1340.00

Thirteen Hundred and Forty Dollars and 00/100

INDORSEMENT HEREOF ACKNOWLEDGES RECEIPT IN FULL OF THE FOLLOWING ITEMS.

1917 # 100 Jan 3 75.00 " 4 50.00 " 8 90.00 " 10 100.00 " 12 240.00 " 14 10.00 " 20 50.00 " 22 100.00 " 30 700.00 $1340.00

MERCHANTS NATIONAL BANK ATLANTA, GA.

1/2

SOUTHERN MILLS CORP'N.

F. P. Blake TREASURER.

FORM 39. VOUCHER CHECK

know the amount owed a vendor, it is only necessary to remove the vendor's folder and add up the unpaid bills. This renders the keeping of vendors' accounts unnecessary because checks drawn cover one or more invoices, an important feature of the voucher system. At all times the total of the unpaid-bill file should equal the balance to the Accounts Payable account in the General Ledger. The paid vouchers should be filed in folders alphabetically by vendors' names.

114. Liquidating Purchases.—In the best systematized factories all cash payments are made by voucher checks. Even petty cash is treated like a vendor and the vouchers for disbursements from it liquidated by means of voucher checks. If all cash transactions are put through the bank, the bank statement or passbook can be readily used as a basis for reconciling the bank balance with the cash account.

115. Voucher Checks.— The use of a "Voucher Check," two styles of which are shown in Forms 38 and 39, provides for obtaining

a receipt from the vendor for the invoices settled. When vendors indorse the voucher checks and the checks are returned by the bank, they can be filed as evidence of the payment of the invoices listed on them. This method of making cash payments does away with the necessity of mailing out vendors' invoices to be receipted and returned for filing.

Voucher checks should be numbered when purchased. As many series can be used as there are banks to be drawn on, a letter prefix being used to differentiate the various series of checks.

116. Cash-Paid Book.— It is necessary to enter all voucher checks drawn in the "Cash-Paid Book," Form 40, before they are

40 CASH PAID No. 1

For Period Ended Jan. 31, 1918

Date	Name	Vr. No.	Accounts Payable	Discount Received	Notes Payable	Interest Paid	Fol.	General Ledger	Bank Pad L. Deposits	Bank Pad L. Checks	Ck. No.	Bank Brad L. Deposits	Bank Brad L. Checks
1918 Jan.	Balance								$10210.00			$10100.00	
Jan.	Standard Oil Co.	1	$1350.00	$3.70						$1313.30	1		
Jan.	Russell & Erwin Mfg. Co.	2	1340.00								4001		$1340.00

Form 40. Cash Paid Book

mailed. Provision is made in this form for operating two bank accounts; more columns may be added when necessary to accommodate additional bank accounts. The majority of checks drawn liquidate invoices set up in the voucher register, and so the amounts are entered in the "Accounts Payable" column of the Cash-Paid Book. The discount taken is entered in the "discount" column. Any checks drawn to liquidate notes are entered in the "Notes Payable" column. Payroll checks and salesmen's advances are best entered in the "General Ledger" column and posted to the payroll and sales-

men's drawing accounts. Daily deposits have to be entered in the proper bank columns in order that the state of the bank balance may be shown at all times.

117. Bills-Payable Record.— A register of the bills payable is a necessary record in order to know just what notes remain unpaid. The notes given are entered in the "Bills-Payable Record," Form 41. When bills are paid, the details of liquidation are entered on the rec-

41 BILLS PAYABLE

Dr. Cr.

Date when Cash Paid	Cash Book Folio	Amount	No. of Bill	Date Given	Name and Address	Payable at	Months	Due	Ledger Folio	Amount
			1	1918 Jan. 2	International Silver Co.	Conn.	12	1918 Jan. 10	6	$1,000

Form 41. Bills Payable Record

ord simultaneously with the recording of the bank checks in the Cash-Paid Book. The open items on the Bills Payable Book when added together should agree with the balance to the controlling Bills Payable or Notes Payable account in the General Ledger.

118. Daily Cash Report.— The "Daily Cash Report," Form 42, is a convenient means of keeping the treasurer informed regarding the status of the bank accounts. The treasurer can tell by a glance at the daily cash report whether he can avail himself of the discounts on all invoices to be paid, or payment must be postponed on some bills. If it is desired to postpone payment on any invoices, a record of the next date when the bill should be paid in order to obtain the most favorable terms should be made on the discount reminder.

At the close of each accounting period the Cash Book should be reconciled with the bank statement by adding all outstanding checks

to the balance shown on the Cash Book. The result obtained after taking into account any collection charges and interest items should give the amount reported on deposit by the bank.

119. **Summary.**— From the foregoing it will readily be seen that purchasing is an important function of a business, and it must be conducted systematically if maximum economy is to be obtained. Material has to be bought before manufacturing operations can be started, and the manager who wants speed and economy in production as well as a high quality product must lay a solid foundation for

42 DAILY CASH REPORT No.

Receipts	For the Day	For the Period	Payments	For the Day	For the Period
Balance Last Period			Accounts Payable		
			Discounts		
Accts. Receivable			Allowance		
Discount			Interest		
Interest			Gen'l. Ledger		
Gen'l. Ledger					
Total Receipts			Total Payments		
			Bank Balance		

Form 42. Daily Cash Report

these things in the form of a properly organized purchasing department. Speed requires that materials needed for the manufacture of the product must be on hand when wanted, and economy requires that the stock must be secured at the lowest price consistent with quality and certainty of delivery. In a properly run plant the purchasing agent's department stands in close relation to certain other departments, such as the manufacturing and engineering divisions. It should be the function of the purchasing department to keep the manufacturing department advised in regard to materials ordered and the probable dates on which they will be delivered. In case the purchasing agent rejects any requisition, the person who made it should be notified. The purchasing agent should be responsible to the general manager for keeping the stores department supplied with the necessary stock. Receiving should be done by someone who is responsible for making the necessary records. The payment of vendors' invoices should be safeguarded in such a way as to insure that each bill has been carefully checked and the distribution of the charge made to the proper ledger account. Purchase records constitute one of the main sources of all information regarding material costs. It is, therefore, of fundamental importance that all records pertaining to purchases be under complete accounting control. Otherwise, misleading information pertaining to the cost of manufacture may result.

The purchasing and voucher system described in this chapter is well standarized and with very slight modifications can be adapted to meet almost any condition found in a factory.

Questions on Chapter IX

1. What is the function of a purchasing agent?
2. What is the purpose of purchase specifications?
3. What use can be made of graphs for the purchasing agent? Give an example.
4. What records does a purchasing agent require?
5. How are catalogues and discount sheets filed?
6. What is the function of a purchase-order form?
7. How should petty-cash disbursements be handled?
8. What is the voucher stamp used for?
9. Describe the operation of the voucher system. What are its advantages and disadvantages?
10. How is the charge-back invoice operated?
11. What function is fulfilled by voucher checks?
12. What is the purpose of a daily cash report?
13. Make out a properly apportioned order to be sent by a retailer to a jobber or manufacturer for shoes; sizes run from 6 to 11, and widths from A to D. Consult some retail dealer.

CHAPTER X

STORES ORGANIZATION

120. Stores Control.— After purchasing material the next step is to tally goods received at the plant and to care for them properly until such time as stock is issued to the factory. The routine followed in receiving, storing, and issuing material is usually referred to as the system of *stores control.* The nature of the enterprise, of course, determines to what extent the organization of the material storerooms should be carried. A storeroom carrying only a few kinds of material does not need so complete a system with so many forms as a stores department handling a large variety of materials. A few illustrations will help to clarify the problem of stores organization in its relation to costs.

121. Material Obtained from Natural Sources.— When material used for manufacturing is obtained from some natural source, as a mine, quarry, or timber land, which is owned by the company, the routine for handling stores consists first in making a tally of the quantity of the product received in the storage yard of the plant. Thus, in a wood-pulp mill a tally has to be made of the number of logs of the various diameters received. The stockkeeper or yardman also makes a tally of logs that he issues to the mill to be put into process, and at inventory time he calculates the logs on hand in the storage yard. The price of the logs is the amount per cord credited to the timber-lands account and also the labor and expense of the logging operations, including delivery to the mill—in short, the total expenditure necessary to deliver the logs upon the mill premises ready to be worked up into some other form. If the pulp mill owns no timber land but purchases its logs from another concern, then the cost of stock equals the vendor's invoice plus any additional handling charges. If a special buyer or estimator or any other man necessary to the economical requisition of the material is carried on the payroll, his salary enters into the material cost. The procedure for handling

material records in a pulp mill is similar to that generally followed in industries using products that are extracted from natural sources.

122. Material Purchased and Put Into Process at Once.— When a company buys its material and puts it into process at once, as is the case in most of the farm products industries, the tally of incoming material answers for that of material put into process. Under such conditions storeskeeping is a simple matter. Thus, in a Wisconsin pea cannery the routine followed is to contract with a grower to take his crop at a certain price, depending upon the grade of peas. The grower, for example, agrees to plant 15 acres daily for 60 days, beginning at a certain date, say, April 15. The first 15 acres planted are the first 15 acres harvested and taken to the cannery. There the peas are measured and payment is made for the number of bushels delivered. The peas go into process the same day delivery is made, and so the cost of material received represents the amount of the material charge to manufacturing. Under such operating conditions the function of storeskeeping is not highly developed and therefore presents few difficulties.

123. Reserve Stocks of Material.— In an industry in which large reserve stocks of material are carried on hand to meet future requirements, the storekeeping function must be developed to a sufficiently high degree to provide not only for a tally of all incoming and outgoing material, but also for keeping a running inventory of what is on hand. The *book inventory,* as it is called, is for the purpose of furnishing a check on the actual count of stock at inventory time. If material is received from the source of supply in bundles, bags, or bales and issued to the manufacturing departments in the original packages, proper accounting for stock is not a difficult matter. A newspaper-publishing plant furnishes a good example of an enterprise in which material is kept and issued in original packages. The rolls of newsprint paper are uniform in size. A stock is usually carried on hand sufficient to run the plant for a period of time in case deliveries from mills should temporarily cease. It is the duty of the storeskeeper to maintain a record of all rolls received and issued, and also to take an inventory when required, as, for example, at the end of each month. A check on the accuracy of the storeskeeper's work can be obtained, because the quantity of newsprint paper required to print 1,000 papers, on an eight-page basis, remains about constant,

varying only from 128 lb. to 131 lb., according to the quality of paper used. Under such operating conditions a high degree of accuracy should be obtained in the stores department without much clerical work.

Continuous-process plants usually use more than one grade of material, which is carried in stock. However, it is quite common, especially in the textile industry, to receive and issue material in the original packages. When this is the practice, even though a number of kinds of material are used, the system of stores control required is not complex. Thus, in yarn mills using raw cotton, wool, or silk, the material comes in bales or bags, marked with indentification symbols, and frequently the weight also is stenciled on the package. The symbols appearing on the bundle correspond with those on the vendor's invoice. This makes it an easy matter to tally and price material received and issued and to take stock when required. On raw silk, for example, the "Chop" ticket identifies the bale as being "Pyramid" or some other brand. The same condition is found in many food factories. Original packages in which dates come are marked with the symbols of the various brands, as "Teddy Bear," "Wedding Cake," and with other distinguishing marks. The conditions prevailing in most process plants where reserve stocks of material are kept are such that the operation of a satisfactory system of stores control is usually not very difficult.

124. **Reserve Stocks in Broken Lots.**— The outstanding feature of stores in most job-order factories is their great variety. A typical plant in any one of the mechanical industries is likely to carry on hand more than a thousand kinds of material, if sizes are considered, and it is not uncommon to find several thousand items of raw material and purchased parts indexed by the purchasing agent. But the various articles carried in stock in the storehouses of most job-order factories are in broken lots, a condition of affairs which increases the difficulty of keeping a record of articles issued, because of the number of items handled. Furthermore, if broken lots of material are carried, the difficulty of keeping book inventories of the stock of material on hand is increased. The most highly developed systems of stores control and organization are found in job-order factories, and especially in the mechanical and assembling industries.

The practice of carrying reserve stocks of material sufficient to

operate the plant for two to three months is quite common. Thus, in a typical automobile factory one is likely to find $2,000,000 or $3,000,000 invested in the stock of materials and parts on hand. A motor-truck building plant with an output of 60 trucks a day would require about 15,000 tires alone to be kept on hand if two months' consumption were taken as the basis for the minimum stock of this item. It is usually considered of the utmost importance that a sufficient stock of material be carried to permit the smooth operation of the factory. When the investment in stores represents a large amount of capital, as is usually the case in mechanical industries such as automobile-building plants, it is essential that an adequate system of stores accounting and control be put into operation. Because of the complexity of the problems of management involved in handling stores in large job-order plants, the office of chief storeskeeper often becomes equal in importance to that of the purchasing agent. The proper arrangement, classification, and accounting of stores in large plants is an important function and frequently requires a large staff. The chief storeskeeper should be able to supervise the clerical work involved in accounting for the receipt, issue, and balance of stores on hand in whatever way the head accountant prescribes.

125. **Personnel of the Storehouse.**— The staff in a storehouse in which a number of persons are employed is ordinarily divided into two parts. One part consists of clerks who are assigned the duty of keeping such stock records as may be required, the other of a staff of assistant storeskeepers who actually handle materials. It would seem best to make the auditor or head accountant responsible for the kind of records kept regarding the receipt, issue, and balance of stores on hand, and to require that the chief storeskeeper supervise the work of the clerks in his department for the purpose of seeing that when the handlers receive certain materials, the recorders record that receipt properly, and also, that after the handlers issue materials to the factory, the recorders make the proper entries. The balance of stores on hand, therefore, fluctuates, and it is the duty of a clerk known as the "balance-of-stores clerk" to notify the purchasing agent in time to replenish stock before it becomes depleted to the point at which the steady operation of the plant is threatened. This balance-of-stores clerk is also responsible for the preparation of the

book inventory at such times as may be required, ordinarily at the end of an accounting period. Stock-ledger clerks or the recorders referred to above, of course, work under the supervision of the balance-of-stores clerk. Assistant storeskeepers or handlers work under the direction of the chief storeskeeper. In large plants it is usually good policy to separate the functions of receiving and issuing goods in order to fix responsibility definitely, prevent collusion, and expedite the work of handling stock. The receiver of goods is responsible for keeping an accurate record of incoming stock. A prompt and rigid system of inspection is necessary in order to protect the factory against mistakes made by supply houses. It is the best practice to require that the receiver of goods inspect, count, weigh, or measure all goods delivered and report the facts to the office, so that the quantities and quality called for on the vendor's bill can be checked. The clerk in charge of issuing material should keep a record of all goods issued by the storeroom.

126. **Fixing Responsibility for Inventory.**— In case bin tags are attached to each bin or rack for keeping track of the stock in each bin, the assistant storeskeepers or handlers are responsible for making the necessary entries on them and for reporting when any item of stock reaches its minimum limit as shown on the ticket. The physical inventory should not be taken by the chief storeskeeper or his staff. The work should be done by representatives of the auditor, although the storeskeeper and his assistants should be present to answer any questions. This is necessary to provide an independent check on the accuracy of the Balance-of-Stores Ledger and also on the bin tickets themselves.

127. **Stores Location.**— The logical arrangement of stores should provide for placing the raw-materials stockroom near the receiving department and the finished-goods stockroom near the shipping department to provide for an orderly flow of material from start to finish. Local conditions, however, must be studied to ascertain which is the best place to keep each class of stock. The location of substores about the plant does not, of course, relieve the chief storeskeeper of responsibility for the custody of the stock. His assistants must be stationed not only in the general storehouse, but also in charge of substores. In assigning stores to their proper locations about the plant, care must be exercised to see that some consistent

plan is adhered to, for it is desirable to keep like classes of stock together.

128. **Stores Arrangement.**— The proper arrangement of the stock is an important feature of the storeskeeper's duties. That the stock be well arranged is a prime necessity, not only that the storeskeeper may be able to find it, but also that he may be able to count it at the time of taking a physical inventory as a means of checking the balances shown on stock records. To begin with, all loose items should be put in uniform lots in order that they may be counted readily. Thus, if articles are piled, there should be 10, 25, 50, 100, or some other uniform number in each pile. The number in an unbroken pile should be noted on the identification tag. Then at inventory time it is necessary to count individually only the articles in the broken pile and to add the number to the total of the whole piles. The same principle applies to any loose articles that may be tied together in uniform bundles. If large quantities of shovels are purchased and carried in stock, they should be tied together in lots of, say, 50. Special attention, of course, must be given to articles purchased in bulk and issued in small quantities. The best practice is to put up such goods in uniform packages which are marked with the quantity in each; in case a single article is wanted, a package can be broken. Then at inventory time it entails but little work to count or weigh, as the case may be, the goods in the broken package and to add this amount to the tally of the material contained in the unbroken packages, which information can be obtained by reading the marks on the packages. In arranging stores an effort should be made to make everything carried in stock readily visible and easy to count without moving the stock.

129. **Waste and Junk.**— A good system of stores organization should provide a separate place for keeping all waste and junk. Regular storehouses and substations are only for active stock used directly for manufacturing or for the storage of merchandise. All waste material and junk should be segregated and provision made to put it in such shape as to make it salable. The proper supervision of the waste-and-junk room is an important function, because many of the mistakes made in ordering and manufacturing come to light there. It should be the practice to take out from the storerooms at regular intervals stock that has been inactive for a long time and

dead stock, and if it cannot be used, steps should be taken to dispose of it and remove it from the inventory.

130. **Storehouse Equipment.**— It is of the utmost importance that the equipment of the storehouse be uniform, elastic, and adapted to meet the requirements of the stock handled. The equipment may be either homemade or purchased from a supply house that sells steel racks and bins in standard units ready for erection. The principle of standard sections should be adhered to for the sake of uniformity. It is convenient to have not only standard-size bins, but also various subdivisions of them to facilitate the handling of stock in large or small quantities. If they are purchased from an outside manufacturer, there are a number of makes to choose from. The best one to select is the one that offers the greatest degree of elasticity so that storage facilities can easily be adjusted to meet the stockkeeping requirements.

131. **Bin Arrangement in a Store Room.**— In arranging the racks, bins, or shelving required for use in the storeroom, it should be the practice not to put them beyond easy reach unless ladders are installed such as those with which shoe stores are equipped. Care should also be taken to see that no bins or shelves are deeper than arm's length. It is a good plan to adopt an arrangement of shelving and bins that will provide about half way up a narrow counter on which to rest goods while they are being selected and counted. The bins should be smaller in the upper part than in the lower; this provides for storing small articles in the small bins and bulky materials in the large bins.

132. **Special Containers.**— Special containers or tanks, of course, must be used for storing fluids such as oils, chemicals, paints, and varnish. The arrangement of whatever tanks are used should provide for elevating them so that the contents can easily be poured into a receptacle held underneath the faucet. When parts are purchased from vendors, arrangements can usually be made to have them put up in standard-size packages ready for issue to the factory. Thus, if it is the practice to assemble in lots of 50 at a time and one of a certain part is required for each article, it saves time to have the parts all ready for issue in lots of 50. It is attention to detail that results in economy and efficiency in the operation of the storeroom.

133. **Counting Machines.**— The introduction of counting machines facilitates the counting of any commodity consisting of similar parts or pieces without the use of tabulated figures of weights, mental calculation, or figuring of any kind. The total count of the contents of any box, barrel, bag, truck, or barrow containing an unknown number of like parts or pieces can be determined accurately, and almost instantly. "Instead of a handful, count a barrel full," should be the storeskeeper's motto. Where counting machines are used, there is no chance for confusion of figures, errors in estimates, or defective calculations, because the accuracy of the count is governed mechanically. By their use mental fallibility is eliminated, and from 50 to 90 per cent of time and labor is saved over every other known method or device employed for the purpose of counting.

The method of counting is one of ratio weight, scientifically applied in a simple machine of few parts, which any ordinary laborer can operate and understand. Although knowledge of the weight of the material handled is at no time a feature in obtaining count, yet whenever it is so desired, weight and count may be secured in practically one operation. Counting machines can be used in all places where checking, counting, and weighing have to be done.

134. **Automatic Scale.**— Much time is saved in weighing material by equipping the storehouse with an automatic scale. All that is necessary is to "load and look." It is of the utmost importance that accurate weights be recorded, and anything that tends toward accuracy should be provided for the storeskeeper's use.

135. **Identification of Stores.**— All stores should be properly labeled and marked in such a way as to enable any one to identify them readily. It should not be necessary to have to depend on the storeskeeper to identify an article or give it the proper trade name. The usual procedure in the case of an article that does not come labeled is to put the name on the bin, rack, or shelf where the commodity is kept. In case bin tickets are used, the name on the ticket identifies the article. Proper identification of stores is an important matter so that the chief storeskeeper's staff does not have to be relied upon to take the inventory. The rule should be adhered to that all articles should be clearly named for identification purposes.

136. **Stores Directory.**— After stores have been properly located, it is necessary to prepare a *stores directory* which gives the exact loca-

tion of every item of stock and which can be used as a guide in finding stock, especially when new assistants are detailed to the storeroom. It is important that racks, bins, and containers be numbered in such a way that their location can readily be recorded on the stores directory. This is a necessary feature of the system of stores administration to the end that any one can go directly to any item of stock when it is wanted without having to ask questions. Racks should be lettered and each tier of shelves or bins given a different series of numbers, starting the 100 series with the bottom row. Then, going from left to right as one faces the stock, the numbers would run 101, 102, 103, and so on, across the bottom row; 201, 202, 203, and so on, across the next row above; and so on. A combination of the rack letter and shelf or bin number on the stores directory gives the exact location of any article.

137. **Maximum and Minimum Limits.**— The efficient operation of a storehouse requires that a maximum and minimum limit be fixed for each item of stores that is at all active. There is danger that the purchasing agent will overbuy in an attempt to guard against a shortage in stock, thereby needlessly tying up capital. In order to prevent overstocking it is the best practice to determine upon the maximum quantity of any article to be carried in stock. It is to be understood, of course, that the maximum quantity determined upon is always subject to adjustment when changed conditions indicate the necessity. It is also necessary to fix upon a minimum limit of stock for the purpose of indicating when it is necessary to place an order to have stock replenished. The minimum limit is supposed to be fixed so that the stock remaining on hand after the minimum is reached will meet the requirements of the plant until such time as the goods ordered for replenishing the stock are received. The need for this arrangement is apparent, for unless some means is provided to insure replenishing stock at the proper time, it is likely that some item may become exhausted without any steps being taken to reorder. The minimum limits established are, of course, always subject to revision as experience may indicate. Both maximum and minimum limits should be noted on the balance-of-stores records.

138. **Stores Turnover.**— In case any stock item has not moved within a reasonable length of time, an explanation should be required. There is the same reason for maintaining a rapid rate of

turnover in the stores department of a factory that there is for a quick turnover in a department store. The average stock on hand for the period divided into the issues gives the turnover. It is essential that the turnover be shown for each storehouse as well as for each substation as a sort of index of efficiency. Thus, if a certain stock has been turning over on an average four times a year and the turnover suddenly drops to three, an investigation can be made and the causes ascertained. It may be that conditions have changed and that the quantities carried in stock will have to be altered. The investment in stores generally represents considerable capital, and it is desirable that this capital give as large a yield as possible. One of the best ways to increase profits is to decrease the quantity of stock carried on hand, provided that the smooth operation of the factory is not interrupted.

139. **Waste, Breakage, and Leakage.**— There are many items carried in stock which are subject to waste, breakage, and leakage. In case of waste due to evaporation, breakage due to an accident, or leakage due to carelessness, it is important that provision be made for reporting the matter to the chief storeskeeper. The form of report used is relatively unimportant so long as the record is sufficiently complete to enable the necessary adjustments to be made on the Stock Ledgers. A rule should be laid down that no adjustments are to be made in stock accounts unless authorized by the head storeskeeper. Otherwise there will be a temptation to cover up errors or hide the amount of loss entailed on account of waste, breakage, and leakage. In this connection it should be explained that all losses occasioned through evaporation, accidents, and carelessness are a direct charge to the Stores Expense account.

140. **Stores Expense.**— The question is frequently raised as to what is the best policy to follow in financing the expense involved in handling stores. By this is meant, "What disposition is to be made of the stores overhead?" If the expense of operating a certain storehouse averages 10 per cent of the cost of stock issued, it means that an item which originally cost $1 must be charged out at $1.10 in order to cover the expense of handling. Each main class of articles would, of course, bear a different burden rate, depending upon the ratio of overhead charges to the cost of material issued. Thus, lumber, iron, parts, paints, and so on, each of which is usually car-

ried in a separate storehouse or division of the main storehouse, would carry a different rate of overhead.

One great advantage of using this method of financing the expense of handling stores is that it puts the stores department on its mettle to keep down the stores overhead expense. Attention should be called to the fact that the standard cost-finding system for the printing industry specifically provides for adding stores overhead expense directly to the cost of stock issued. The report of the Cost Committee of the Printers' Association suggests that in their industry a rate of 10 per cent be added in order to cover the expense incurred in handling stores.

141. **Summary.**— It is safe to say that no satisfactory system of cost accounting can be operated unless all material is kept under proper control and a stores department thoroughly organized. The receiving, issuing, and keeping of stock records form one of the most important links in the chain of transactions which commences with the purchasing of material and ends with the shipment of the finished product.

QUESTIONS ON CHAPTER X

1. How should the personnel of a storehouse be organized? What is the function of the chief storeskeeper and his assistants?
2. What is the best location for stores in order to facilitate an orderly flow of material from start to finish?
3. How should stores be arranged so that they can be readily inventoried and found when wanted?
4. How should waste material and junk be handled?
5. What kind of equipment is best suited to meet the requirements of a storehouse?
6. How should bins be arranged?
7. What mechanical means can be introduced to facilitate counting material?
8. What kind of scales are best suited for weighing material?
9. What steps should be taken in order to provide a means of readily identifying stores?
10. What use is made of a stores directory?
11. How are maximum and minimum limits fixed?
12. How is the rate of stores turnover calculated?
13. To what account should waste, breakage, and leakage be charged?
14. How should stores expense be handled?

CHAPTER XI

STORES CLASSIFICATION

142. **Stores Symbols.**— In an establishment having a considerable number of different items in stock, a proper system of storeskeeping requires that the stock be carefully classified to the end that it may be intelligently handled and controlled. An orderly arrangement of stores cannot be obtained unless a good system of classification is established. In case it is desired to put into operation either a numerical or a mnemonic code for classification and identification purposes, it is of fundamental importance that a complete catalogue of stores be made and symbols used to identify each article according to some system.

143. **Mercantile Storeskeeping.**— The highest development in the art of storeskeeping is found in mercantile establishments because there the function of storeskeeping is given more attention than it is in factories. It is, therefore, to the successful dry-goods merchants that one would naturally look in order to ascertain the fundamental principles of good stores arrangement and classification. Upon visiting any one of the leading dry-goods stores in a large city, the first thing that impresses the customer is that everything is highly departmentalized and that related lines are kept in close proximity to one another. It requires only a few visits to a store to learn just where to look for any article wanted. Within each department there is followed out an orderly arrangement which helps the salesman readily to locate any article in a particular style, weight, or size wanted. In order to record the vast quantity of detail required in keeping track of everything that the buying public wants, some department stores have put into operation a highly organized system of stores classification and have devised various symbols for the identification of the different articles handled. Factories, for the most part, can learn much from mercantile establishments, although in those industrial establishments run under the Taylor system of scientific management all stock is arranged and classified as completely as possible.

144. Classification Systems.— The simplest system of classification is one which provides for grouping like commodities together. Thus in an industrial plant certain lines of goods will be purchased, such as lumber and millwork, hardware, metals, chemicals, oils and paints, electricians', engineers', and plumbers' supplies, each of which can be subclassified into groups and subdivisions until every article finds its proper place in the general scheme of arrangement. A simple method of making the classifications for purposes of record-keeping is to arrange the main groups alphabetically and then to arrange the items in each subgroup alphabetically. This is a simple method, but it is not a very satisfactory plan if there are a large number of items, because no two persons can be relied upon to call any one article by the same name. Because of this inaccuracies are likely to creep in, and hence a numerical or mnemonic code gives better results than any ordinary alphabetical arrangement.

145. Numerical Code: Block System.— The simplest method of devising a numerical code is to assign a block of numbers to each class of goods handled. Thus, numbers from 1 to 99 may be for lumber, 100 to 199 for steel and iron, 200 to 299 for oils and chemicals, and so on. The next step is to arrange the commodities within each group according to some order and to assign a number to each item.

146. Numerical Code: Dewey Decimal System.— The highest development of numerical codes is found in the Dewey decimal system which is so generally used in public libraries for the purpose of cataloguing books. The significant feature of the system is that the position of the number with relation to the decimal point indicates the class or subclass. Thus:

600. USEFUL ARTS
- 610. Medicine
- 611. Anatomy
- 612. Physiology, etc.
- 620. Engineering
- 621. Mechanical Engineering
- 622. Mining Engineering
- etc.

Following out this plan we would finally come to the 660. class, which is Chemical Technology, and the 666. class which is Ceramics

— glass, clay, cement, etc. Thus, it is seen that a number according to its position such as 600, 60, or 6 may be used to indicate different classifications and subclassifications.

The operation of the Dewey decimal system requires the use of a cross index to enable one to find the number corresponding to the kind of books which it is desired to classify. Thus, under the C's we find such a list as this:

C

Centripetal force, physics	531.35
Ceramic productions, building	691.4
Ceramics, fine arts	738.
Ceramics, manufacture	666.3
etc.	

One of the principal arguments in favor of the Dewey decimal system is its elasticity. By this is meant that at any time a new subclass can be inserted in the code without the necessity of re-arranging the items already classified. It follows that the code can be indefinitely expanded so as to provide for as many subclassifications as desired and still have all of the items arranged in a logical order.

The underlying principles of the Dewey decimal system can usually be adapted to the classification of stores. The plan has been applied to a good many plants with considerable success. In order to devise a decimal code it is first necessary to make a study of all the items carried in stock with a view to the development of a logical plan of grouping together commodities having similar attributes. The best procedure is to make out a card for every item on the inventory. Then guide cards can be used for the purpose of separating the individual-item cards containing the description of the various articles into a few main commodity classifications. If it is thought that the items in a group will not exceed 10, the numbers 0 to 9 can be set aside for them, but if it is thought that the items may total more than 100, the numbers 0 to 99 have to be allotted to the group or class, and so on. The expansion to be provided for, of course, determines the size of the code. Thus, we hear a code spoken of as containing four, six, or eight figures, and so on, depending upon the detail to which it is necessary to go in classifying items. An example of a five-figure code is as follows:

20,000. Hardware
21,000. Corner plates, irons, braces, and box corners
21,100. Plates, flat corner
21,110. Wrought steel, galvanized
21,111. Wrought steel, galvanized, 3″ x ¾″ x 3/32″

In the index a galvanized wrought steel plate with flat corners, 3 by ¾ by 3/32 in., would be given the number 21,111, as above indicated.

147. Uses of the Decimal Point.— It frequently happens that it becomes desirable to expand some particular classification or to provide for indicating sizes or prices. This can be done conveniently by means of a series of numbers following the decimal point. The numbers from .01 to .99 could be used for the purpose. For example, units of measure can be indicated thus:

.01	inch	.04	gill
.02	foot	.05	pint
.03	yard	.06	quart
	etc.		etc.

One of the principal uses of a numerical code is to facilitate the tabulation of records, especially when done by means of the punch card and automatic sorting and tabulating machines. The operation of this device will be explained somewhat in detail in a subsequent section. All that is necessary to point out here is that the operation of a system of mechanical tabulation requires the use of a numerical code for the purpose of recording the proper classification of the data to be tabulated. The use of numerical symbols as a means of facilitating the tabulation of stores records is a highly desirable plan.

148. Mnemonic Symbols.— The use of letters that suggest the name of the article or commodity classified is called the mnemonic system. Many persons, especially efficiency engineers, prefer letters to numbers because letters afford greater ease in remembering symbols than when numbers only are used. An example of the use of letters that suggest names is found in recording dealings in securities on the New York Stock Exchange. Thus, the symbol ABS stands for American Beet Sugar; AIC, for American International Corporation; AF, for American Car and Foundry; CG, for Consolidated Gas; and so on. After a little use of these Stock Exchange symbols

in connection with the names for which they stand, one is not likely to forget the words they represent.

The procedure usually followed in making up a mnemonic classification is to prepare first what is known as a "base sheet," which contains all of the letters of the alphabet except I and O, omitted because of their similarity to numbers. The next step is to write the names of the main classes of articles to be codified opposite letters which are either the initial letters of the commodity class or are predominant in the sound of the name of the group. Thus, S is used as the symbol to represent stores, and all items of stores would be indicated by a mnemonic symbol beginning with the letter S.

The next step is to take the main classes of stores and assign letters somewhat as follows:

A.	Apparatus for laboratories	N.	
B.	Brushes	P.	Photographer's supplies
C.	Cabinets for filing	Q.	
D.	Drugs and medicines	R.	
E.	Engraving, printing, stationery	S.	Steel and iron
F.	Furniture and floor coverings	T.	Typewriters and repair parts
G.	Glass	U.	
H.	Hardware	V.	
J.		W.	Window shades
K.	Cordage	X.	
L.	Lumber, millwork, and packing boxes	Y.	
		Z.	
M.	Motor trucks		

The above list shows how letters can be assigned that are the same as the initial of the class of stores. In case there is an overlapping it is necessary to use some letter other than the initial, possibly one having a predominant sound in the name of the article classified. According to this scheme of classification, brushes would be SB, glass SG, when carried in stores, and so on. The code can be extended to cover as many subclassifications as desired.

149. Combination of Letters and Numbers.— It is frequently desirable to introduce numbers into a mnemonic code for the purpose of showing such details as location, size, brand, etc. Thus, the location of a sub-storehouse may be indicated by a number after the S in the symbol. Also the letters indicating a galvanized wrought-steel plate with flat corners could be followed by the numbers 3″ x ¾″ x 3/32″ to indicate the size.

150. **Stores Catalogue.**— It is necessary to prepare an alphabetically arranged stores catalogue for reference in assigning the proper code symbols to all articles. In order to illustrate how a stores catalogue looks, reference will be made to a part of one taken from the catalogue of a straw-hat manufacturer; the list shows how the bodies are classified that are used for making Panama and other hats made from bodies:

100		Borodino	
	101		Natural
200		Columbo	
	201		1st Grade
300		Felt	
	301		Small Shapes
	302		Ladies
	303		Cerise
400		Hatter's Plush	
	401		Silk
500		Java	
	501		1st Grade
600		Leghorn	
	601		Natural
	602		Bleached
	603		Black
	604		Green
700		Linen Body	
	701		1st Grade
800		Manila	
	801		1st Grade
	802		2nd Grade
900		Palm	
	901		Large
	902		Small
1000		Pandana	
	1001		1st Grade
1100		Panama	
	1101		1st Grade
	1102		2nd Grade
	1103		3rd Grade
	1104		4th Grade
	1105		5th Grade
	1106		6th Grade
1200		Peanut	
	1201		1st Grade
1300		Sungora	
	1301		1st Grade
	1302		2nd Grade

151. **Uses of a Code.**— A code is useful for the purpose of identifying every article carried in stock. The practice is for the purchasing agent to put the code symbol, which he obtains by referring to the stores catalogue, opposite each item on a purchase order. A duplicate of the purchase order then goes to the receiver of goods, and he marks the number on an identification tag which is either attached to the article or fastened to the bin or rack where the goods are kept. Any one withdrawing goods on stores requisitions must refer to the catalogue and obtain the proper code symbol. Also at inventory time the stock is taken according to the symbols used for identification purposes. Then, too, the stores records are all arranged by the code symbols. The use of the symbols, it is thus seen, makes it possible to identify any article definitely on all records.

152. **Summary.**— The operation of a complete stores classification system furnishes the best means for accurately identifying stock. A properly devised code for use in designating each article is a most valuable adjunct to the system of stores control and administration. It is safe to say that one cannot accurately keep track of a large variety of stock without making use of an adequate classification code.

Questions on Chapter XI

1. What end is served by a proper classification of stores?
2. Give an illustration of a simple stock classication by grouping like commodities.
3. How is the block system of numbers operated for classifying stores?
4. What is the Dewey decimal system? Give an illustration. How is the decimal point used?
5. What are mnemonic symbols? Give an illustration of a mnemonic classification.
6. Under what conditions is it desirable to combine letters and numbers when making up a code?
7. How is a stores classification code used after it has been devised? Give an illustration.
8. Make a classification code for use in a house dealing in underwear. There are both men's and women's underwear; it comes in light, medium, and heavy weights; in $1, $2, and $3 grades, and in six sizes.

CHAPTER XII

TYPICAL FORMS AND ROUTINE CONNECTED WITH THE RECEIPT AND ISSUE OF STORES

153. Requests for Stock.— Factory stores, for the most part, consist of raw material, supplies, small tools, manufactured parts, and finished goods. In a trading concern it is the usual practice to speak of finished goods as merchandise. When the stock of any item requires replenishing, it is necessary for the chief storeskeeper to make out a request for an additional supply, in order to prevent a shortage when articles or commodities are called for. The "Requisition on Purchasing Agent," Form 31, for raw material, supplies, or small tools is sent direct to the purchasing agent, as explained in Chapter IX, so that orders may be sent out to vendors or the necessary contracts entered into. Requests for manufactured parts which are produced by the establishment itself are sent to the shop-order or planning department, where production orders are prepared for issue to the factory departments to have the necessary parts made. Requests for finished goods or merchandise also go to the production-order department, which issues the necessary factory orders to the manufacturing departments.

154. Receiving Record.— Sometimes the plan is followed of giving the receiver of goods a "Receiving Record," Form 43, for use in reporting the articles received. Under this plan it is customary to make the record of receipts so complete that it furnishes all the information needed by the voucher clerk for checking the quantities on the vendor's invoice. The Receiving Record is also used as the basis for making entries on the received side of the Stores Ledger. The Receiving Record is best made in duplicate so that a copy can be preserved in book form. From the Receiving Record postings are made to the Raw Material Stores Ledger, Form 1. When filed, the Receiving Record furnishes a chronological list of all goods received. The same care should be used in making entries on it as in making entries in the Cash Received Book.

Purpose of record of stores received.

155. Reports of Stores Issued to Factory.— After stores have been properly received and put in stock, they are available for issue to the factory. It is necessary to fix responsibility for handling stores and for making a record of the stock issued. In order to determine just what procedure must be followed in issuing stores and in making a record of the stock put into process of manufacture, local conditions must be studied carefully. In general, it may be said that

43 **RECEIVING RECORD** Receipt No.

Date _____ Purchase Order ____

Received From _____

How Received _____ Charges _____

Quantity	Size	Quality	Description

Received By	Checked Purchase Order	Entered Inventory

Form 43. Receiving Record

usually either the record of stock issued is made in the form of a storeskeeper's daily report, or else stock is issued on requisitions which are made out by the persons desiring material and left with the storeskeeper as a receipt for the goods. When requisitions are used, it is unnecessary for the storeskeeper to make a daily report of stores issued, because the requisitions furnish the office with the needed information regarding stock consumed.

The plan of having storeskeepers make a daily report of stock issued seems to be best adapted to meet the requirements of standard-product factories, because the process of furnishing raw material to the factory is usually continuous. Thus, in a cotton mill, where bales of cotton are continually being put into process, all that is required is a daily report of cotton opened.

Requisitions are mostly used for drawing stores in factories where

the product is made on production orders. Under such conditions the exact quantity and kind of material required for each order must be drawn out of the stockroom when manufacturing operations are begun. Thus, in a straw-hat factory the plait and trimming material required for the manufacture of a particular style has to be drawn from the stockroom on a requisition. When requisitions are used, they show the job number to which material is charged. In this connection it may be added that requisitions are frequently used for drawing supplies chargeable to factory overhead, in which case, of course, no job number would appear on the requisitions. However, it is often the practice to make use of certain symbols for the purpose of indicating the main- and sub-account classifications to which supplies are chargeable.

156. Recording of Stock Issued.— The storeskeeper's daily reports of stock issued or the factory requisitions for stock constitute the basis for making entries on the issued side of the Stores Ledger cards. These reports and requisitions are also used as the basis for calculating the cost of material consumed in the different manufacturing processes or applied to specific jobs. The usual procedure is to pass the daily material reports or factory requisitions first to the balance-of-stores clerk, who makes the necessary entries on the issued side of the Stores Record cards and also makes the extensions required in order to arrive at the money value of the material issued. This can readily be done because the Stores Ledger cards ordinarily show the unit prices. Stores reports and requisitions can then be sent to the cost department, so that the clerks there will have the necessary data regarding material used when figuring the cost of production.

At the close of each accounting period the total cost of stock used must be credited to the proper stores accounts and charged to some General Ledger cost account, such as Work in Process or Expense. In order that this may be done, it is necessary that a daily summary of all stores reports or factory requisitions be made, according to the class of goods issued, as a basis for making entries in the General Ledger.

The design of stores reports and requisitions must, of course, be such as to meet the needs of local conditions. However, there are certain features that are common to the design of a great many of the

forms used. Accordingly, reference will be made to some of the typical forms used in representative plants.

157. Storeskeeper's Daily Report of Stock Issued.— In continuous-process factories that use but a single kind of raw material, it is customary to require of the person who is responsible for putting goods into the process of manufacture a daily report of the stock issued from the storeroom. His reports should be prepared with the highest degree of accuracy, for they form the basis for making a charge to the Work in Process account and a credit to the Raw Material account. These reports are also used, as previously stated, as a basis for making entries on the issued side of the Stores Ledger cards, several forms of which were presented in an earlier chapter. Examples of factories in which daily raw-material reports are used are cotton mills and tanneries, and consequently reference will be made to the forms used in these industries.

44 REPORT OF COTTON OPENED

Overseer B. Stearns Date Jan. 2, 19

Variety	Grade	Lot No.	Pounds Gross	Pounds Tare	Price	Amount	
Uplands	Middlings	302	500	15	$.20	$100	00

Form 44. Report of Cotton Opened

158. Report of Cotton Opened.— In a cotton mill it is necessary to supply the card room with sufficient cotton to keep the picking machines filled to capacity. The machinery in a mill is ordinarily set for using but a single grade of cotton, and so it is an easy matter to have a daily report made out showing the stock issued to the operating departments. The ties have to be cut and the bagging removed from the bales, after which the cotton is weighed

separately from the ties and bagging. The "Report of Cotton Opened" is shown in Form 44. Provision is made in the various columns for entering the variety and grade of cotton, lot number, pounds, price, and amount. The storeskeeper fills in all but the last two columns, which are filled in by clerks in the office. An entry for a bale of Uplands middlings cotton is illustrated. The footing to the amount column gives the amount to charge the Work in Process account and to credit to the Cotton account.

159. Record of Raw Hides Issued.— The employee in a tannery to whom is assigned the duty of putting raw hides into process of

45

RECORD OF RAW HIDES ISSUED

For the Period Ending Jan. 2, 19

Lot No.	Pack No.	Description	No. of Hides	Pounds	Price		Amount	
1	1	Native Steer	50	2,000	$	50	$1,000	00

Storekeeper Entered on Stock Record

Form 45. RECORD OF RAW HIDES ISSUED

manufacture is usually required to make out a "Record of Raw Hides Issued," such as illustrated by Form 45. A tannery may be equipped to handle 1,000 hides daily, in which case the Record of Raw Hides Issued would show the lot number, pack number, description, weight, price, and amount of the 1,000 hides used daily. Form 45 shows how the entry would appear for an item such as a pack of 50 native steer hides which weigh on an average 40 lb. each. The daily Record of Raw Hides Issued is signed by the storeskeeper and also by the balance-of-stores clerk, who makes the entry on the issued side of the Stock Record, which should be kept with the same degree of care that is given to the General Ledger accounts. Upon

the accuracy of the stock records depends the correctness of the figures used in calculating the cost of material consumed in making leather. Inasmuch as the raw hides used constitute by far the largest single item of cost in a tannery, it is apparent that any error made in accounting for hides will tend to throw the total cost figures out. The procedure followed in preparing daily reports of cotton or hides issued to the factory is suggestive of the method used in other process plants.

160. Requisition.— There are many plants in which the storeskeeper has to be advised of the wants of the factory by means of

46

REQUISITION ON STOREKEEPER No. 1

Storehouse No. 1 Date

Description	Quantity	Unit	Price	Amount	Total

Charge Acct. Foreman

Form 46. REQUISITION ON STORESKEEPER

stores requisitions. Requisitions are used, for the most part, in factories where many different items are carried in stock, as in the mechanical industries, in contrast to the few kinds of material used in continuous-process plants, such as textile mills, tanneries, and so on. Where factory materials and supplies are issued only on stores requisitions, it is necessary to have the quantity and description of each item accurately entered on the requisitions. Usually the requisition is given to the storeskeeper, and after the goods are issued, the person receiving them receipts for them on the requisition. In some cases stores requisitions are made in duplicate; the original is left with the storeskeeper as a receipt for the goods, while the dupli-

cate accompanies the goods to their destination. A common type of stores requisition is illustrated in Form 46. It provides for entering the quantity, unit, description, price, and amount, and it can be used in a large variety of plants without making any change in form.

161. Stock Memorandum.— Another form of requisition is illustrated by the "Stock Memorandum," Form 47. Either the production-order number or the standing number is entered in the spaces provided in the upper right-hand corner. The body of the Stock

47 STOCK MEMORANDUM

Date	For Department	Foreman	Order No.	S.O.No.

Quantity	Description	Filled in by Office	
		Price	Amount

Delivered by	Received by	Deducted Stock	Charge Account

FORM 47. STOCK MEMORANDUM

Memorandum provides for entering the details of the items wanted. It is expected that the persons who deliver material, receive it, make the necessary entry on the Stock Record, and classify the charge, will put their initials at the foot of the form, in order to fix the responsibility for each step in the handling and recording of stock. When the goods delivered are entered on the issued side of the Stock Record card, the price is noted on the Stock Memorandum and extension made in the columns provided for the purpose.

162. Cutting-Room Record of Linings.— Where yardage is continually being cut up, as in the cutting room of a shoe factory where linings are prepared, it is necessary that some plan be applied for exercising control over the quantity of goods used. A common method is to make use of a record such as that shown in Form 48.

A separate record is required for reporting the quantity of material used on each order. Provision is made for showing the yards allowed on the estimate of the quantity of material required, as well as the yards actually consumed. By this means a comparison is made readily between the goods which should be cut and the quantity actu-

48 CUTTING ROOM RECORD LININGS

Date _____ Order No _____
Emp No _____

Number Parts	Description	Yards Allowed	Yards Consumed	Lot Number

Remarks.

Return to Office When Completed.

FORM 48. CUTTING ROOM RECORD OF LININGS USED IN SHOE FACTORY

49 MEMORANDUM OF HEELS

The A. B. Co
Date _____ Department _____
Enter all Heels by Lot Number

Lot No	No Pairs	Height	Grade	Description	Filled in by Office	
					Price	Amount

FORM 49. MEMORANDUM OF HEELS USED IN SHOE FACTORY

ally used. A recapitulation of the cutting-room records at the end of each month is the means of learning the efficiency with which the cutting of lining material is done. In case the actual yardage consumed exceeds the quantity figured on the estimates, an investigation should be made in order to ascertain who is responsible for the waste.

163. Memorandum of Heels.— Another good example of a case in which operatives report the material used is found in the department of a shoe factory where the heels are attached to the rest of the shoe. A "Memorandum of Heels," Form 49, is used in making a report of heels used. Space is provided for recording the lot number to which the heels belong, the pairs used, together with the height, grade, and description, as shown. At the end of each day the Memorandum of Heels is sent into the office, where the different items are

priced and extended to give the figure to use in charging the Work in Process account and in crediting the Heels account. This is a necessary part of the accounting procedure in a shoe factory. The practice followed in a shoe factory in reporting lining material and heels used is applicable to any industry in which raw material is kept in stock in the operating departments within easy access of the employees.

164. Dimension List.— There are cases in which it is impracticable to obtain an exact record of the quantity of material used on

50 DIMENSION LIST Job No.____

Listed by_____ Page No.____

Material_____ Cut by_____ Weighed by_____

Item	Pieces	Gauge	Grade	Cutting Size	Elev	Sec	Description	Weight Gross	Weight Ret'd.

Form 50. DIMENSION LIST

a job from either the storeskeeper or operatives; then the material required has to be estimated by the draftsman from blueprints and specifications. Such a condition is found in a metal-furniture factory, where lengths of material are constantly being issued from the stockroom and cut up into the sizes called for by the blueprints and specifications. The practice is, therefore, for the draftsman to prepare a "Dimension List," Form 50, from his knowledge of the material required as shown by the drawings. It is obvious that all the material estimated to be required must be used in manufacturing a piece of steel furniture. At the end of each month the total of the estimated cost of the material must be charged to Work in Process and credited to the Raw Material Stock account. If the total of the

material reported issued by the storeskeeper exceeds the aggregate of the material estimated on the dimension lists, it indicates excessive waste, and an investigation should be made to fix responsibility for the leak.

165. Distribution of Material.— It is a necessary part of the procedure in accounting for stores to provide a form on which the

51 DISTRIBUTION OF MATERIAL

For the Period Ended 19:

Day					
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
Total					

Form 51. DISTRIBUTION OF MATERIAL

various storeskeepers' reports and requisitions can be summarized under the proper ledger account classifications. The "Distribution of Material" sheet, Form 51, is a convenient record for this purpose. The procedure is to tabulate the daily reports and factory

requisitions each day, entering them opposite the day's date in the proper columns, which would be headed ordinarily somewhat as follows: "Raw Material," "Manufactured Parts," "Supplies," "Tools," "Finished Goods," and so on. When all of the reports and requisitions have been entered for the month, the columns are footed and the proper journal entries made in the ledger, such as charging the Work in Process account and crediting the Raw Material account for the amount shown by the footing of the "Raw Material" column, or charging Expense and crediting Supplies for the amount of supplies used.

166. Raw Material Returned to Stock.— It frequently happens that material that has been drawn out of the storeroom is not used by the factory. In this case it is necessary that the unused stock be returned to the storeroom and credited to the account to which it was originally charged when issued. The best method of returning goods to stores is to use a ticket similar to a stores-requisition form but of a distinctive color and with an appropriate heading. The returned-stores tickets should be initialed by the storeskeeper and forwarded to the office, so that entries can be made on the received side of the perpetual inventory cards, and also that necessary entries can be made to the controlling inventory accounts in the General Ledger.

In the case of new material returned to stock, it is credited at the same price at which it was originally issued. However, if such returned material is defective and can be only sold for scrap or junk, a price must be put on it at which it will sell. The difference between the price at which it is taken into stock and the price at which it was originally issued must be charged to the Factory Expense account under the proper subclassification.

167. Summary.— So far as the accounting procedure is concerned, it does not make any difference where the material is located or how the record is obtained. The aim is always to make records in such a way that they show when the stock was used and to what account it should be charged. Records of stock consumed are used as a basis for deducting the stock issued on the Stores Ledger cards and also for making a credit to the various controlling inventory accounts in the General Ledger. When this procedure is carried out, no difficulty should be experienced in reconciling the details of a physical inventory with the balances shown on the subsidiary Stores Ledger

and the totals of the inventory with the balances appearing on the General Ledger controlling inventory accounts.

All the records for keeping track of stores thus far explained are designed to be written by hand, but there are various mechanical devices that can be used to reduce the clerical work. These will be described in a subsequent chapter under the head of mechanical aids to cost work.

Questions on Chapter XII

1. What is the usual procedure for replenishing stock?
2. Who should be responsible for following up deliveries from vendors?
3. Who should be held responsible for the proper receiving of goods?
4. What purpose is served by a Receiving Record?
5. What use is made of a Report of Stores Issued? Give an example.
6. In a plant where the pieces of material required are cut from full lengths of stock, how is the cost of the material used best calculated?
7. What procedure should be followed when material is returned to the stockroom in a factory? At what price should it be credited to the factory?
8. Design a receiving record to be used by a jobber in woolens. The date, vendor's name, quantity and description of goods received, and remarks columns must be provided for.
9. Design a receiving book to be used by a hospital. Distribution columns are to be provided for showing the supplies delivered to the following departments: stores, housekeeping, kitchens, wards, pharmacy, and laboratory.
10. Devise a record of goods received and a record of goods issued to be used by a public warehouse. Provision is to be made for entering the date, name of depositor, and quantity and description of articles. The original of the record of goods received is to be in two forms, one of which is "Negotiable" and one of which is "Non-Negotiable."

CHAPTER XIII

PERPETUAL INVENTORIES: STORES ACCOUNTS

168. Stores Ledger.— The generally accepted method of exercising control over inventories and material costs is to operate what is known as a "perpetual-inventory system" or Stores Ledger. The operating procedure of the perpetual-inventory record is to open as many stock accounts as there are items carried in the storeroom. Stock-record forms usually provide for showing the receipts, issues, and balance-on-hand. The most important feature is, of course, the balance-on-hand, because of which the perpetual-inventory system is frequently spoken of as a "balance-of-stores record" and the clerk who keeps it as the "balance-of-stores clerk." Perpetual-inventory cards always show quantities and may or may not show money values. The use of a perpetual-inventory system is a check on the physical inventory when taken, for each item should agree with the balance shown on the Stores Ledger. The operation of a perpetual-inventory system is a great help to the buyer, since it enables him to see how each item is moving when he is preparing a purchase order for the purpose of replenishing the stock. This enables the buyer to purchase intelligently and this is one of the strongest arguments in favor of introducing a perpetual-inventory system. Intelligent buying of material makes it possible to operate the plant with a smaller investment in stock on hand. Clerical expense involved in maintaining a Stores Ledger is offset by the saving due to a smaller investment in stock and also to the smoother operation of the plant when the likelihood of running out of material is diminished.

169. Numerical vs. Alphabetical Arrangement.— There are two principal plans of arranging the Stores Ledger in order to operate the perpetual inventory efficiently and accurately. Stock-record cards or loose-leaf sheets can be arranged either numerically, in accordance with a classification code such as previously described, or alphabetically under group headings. The same arguments used for

and against the numerical system of filing correspondence apply to the arranging of the Stores Ledger according to stock numbers. The principal argument advanced in favor of the numerical arrangement of the stock record is that a number is more quickly located when a proper system of guide cards is used than is a name, and that if a number is misplaced, the mistake is more easily detected than when a name is improperly filed. Constant use of the numbers by those who handle the stock records enables them soon to remember the numbers, and they seldom have to refer to the code index when a number is wanted. Experience has shown that it is impossible to teach every one handling the stock, as well as the records, to refer to the same item by the same term or sequence of words. Thus, for example, if it is desired to open an account for tack hammers, one clerk will file the record under the main classification of "hammers" and subclassification of "tack," so that any one consulting the Stores Ledger will not find the item unless he looks under "hammers." Another clerk may reverse the procedure and file the record under "tack hammers" as the main classification, so that one must look behind the "Ta" guide to find the item. Such a state of affairs naturally leads to confusion, inaccuracy, and a considerable waste of time. Because of this danger, the use of a numerical code for stock records is meeting with increased favor. If a mnemonic code, made up of letters suggestive of the names of the articles, is used, or a combination of letters and numbers, the Stores Ledger can be arranged accordingly. The use of a code always prevents the application of the same symbol to two different articles or the filing of the same commodity in two different ways.

170. Cards vs. Loose-Leaf Stock Records.— Stores Ledgers are for the most part of the card or loose-leaf variety, bound books having been abandoned generally for the purpose of keeping stock records according to the perpetual-inventory system. In the first place, it must be remembered, on the one hand, that the Stores Ledger is always being added to when new kinds of stocks are purchased, while on the other hand, it is constantly being diminished when the record of dead or obsolete stock is taken out and removed to a transferred file in order to leave the active part of the stock record as compact as possible. The principal arguments in favor of card stock records are as follows:

1. Stock records kept on cards are the most elastic in form because they permit the addition of new cards and the removal of old records without unlocking a binder.

2. The filing of the stock-record cards behind a proper system of guide cards provides a quick means of reference to any card wanted.

3. A proof of the work done in posting stock records can be made before returning cards to the file by simply adding up the entries on either the received or issued side bearing the day's date and comparing the total thus obtained with a summary made from the original documents.

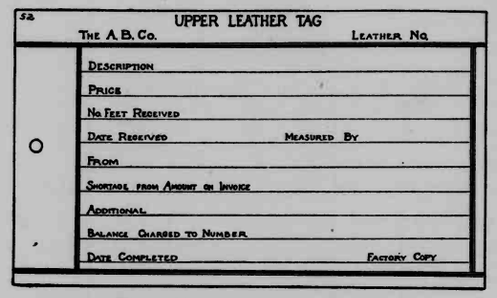
4. Cards can easily be sent to the buyer for his information when making a purchase so that he can see how the stock is running.

One of the objections raised to the use of cards is that they are likely to be lost. The answer to this objection is that when cards are used, proper safeguards should be put around them, just as the paymaster or cashier is safeguarded from interference by means of the necessary grill-work. Experience has shown that large quantities of stock records can be handled without ever losing a card. Unless there is some good reason to the contrary, the Stores Ledger should be in card form.

√171. **Money Cost Shown on Stock Records.**— Stock-record forms differ radically in one respect, and that is in the provision that is sometimes made for recording not only the quantities on hand, but also the money cost of such quantities. The introduction of columns showing amounts as well as quantities increases the clerical work of keeping the Stores Ledger. However, if it is desired to operate the Stores Ledger as subsidiary to a controlling account in the General Ledger, it is necessary that the balance in terms of money be shown. Before one can determine just what type of records is best suited to meet the requirements of an individual case, local conditions must, of course, be studied. In case the Stores Ledger is kept by clerks who are not highly trained in bookkeeping work, it is better not to undertake to keep money costs on the Stores Ledger. However, if the work of making the entries in the Stores Ledger is done by well trained clerks and is under competent supervision, there is no reason why amounts as well as quantities should not be shown. The operation of the Stores Ledger so as to show money items makes it possible to draw off a statement at any time showing the investment in stock carried

in the storehouse, and thus effect a reconciliation with the controlling account in the General Ledger. The keeping of the Stores Ledger so as to show money values as well as quantities represents the highest development of a perpetual-inventory system.

172. **Location of Stores Ledgers.**— It is necessary to make a study of the conditions existing in any plant in order to determine where it is best to keep the Stores Ledger. Stock records may be kept in the stockroom, or in the office, or in both places. When kept in both places, it means that to a certain extent the record is dupli-


52 UPPER LEATHER TAG
THE A. B. CO. LEATHER NO.
DESCRIPTION
PRICE
NO. FEET RECEIVED
DATE RECEIVED MEASURED BY
FROM
SHORTAGE FROM AMOUNT ON INVOICE
ADDITIONAL
BALANCE CHARGED TO NUMBER
DATE COMPLETED FACTORY COPY

FORM 52. UPPER LEATHER TAG

cated. Unless the plant is very small and the storeskeeper has a certain amount of spare time, he can hardly be expected to act in the capacity of both storeskeeper and balance-of-stores clerk. In a plant of sufficient size to warrant a perpetual-inventory system, at least one or more clerks are assigned to the duty of posting the Stores-Ledger cards and to that of drawing off the balance-of-stores report. This work may be done either in a corner of a storeroom, in an office provided for the purpose, or in the central office of the plant. The argument generally advanced for keeping the records in the storehouse is that the clerks are in closer touch with the stock and are, therefore, in a better position to detect mistakes and correct errors than if they were stationed away from the storehouse in a central office. Local conditions must decide which system is to be preferred.

√173. **Lot Number System.**— It frequently simplifies the operation of a perpetual-inventory system if goods are kept by lot numbers. By this means it is possible to exercise control, not only over

each kind of material carried in stock, but also over each individual lot. This practice makes it easy to segregate discrepancies and to keep track of the stock. When used, a lot-number tag has to be made out for each lot received.

174. Upper Leather Tag.— In order to illustrate the operation of a lot-number system, reference will be made to the "Upper Leather Tag," Form 52, used in a shoe factory. The form is made out when a lot of upper leather is received. The tag should be in

53 Rack	Locker	Minimum
Classification and Item Number		
Date	On Hand	Received	Issued

Form 53. BIN TAG

duplicate, so as to provide a copy for the office. The duplicate copy is the one attached to the stock, which is put in a separate compartment in the storeroom in order to prevent confusion and mistakes. When the whole lot has been issued to the factory, the tag should be returned to the office, so that the stock record can be consulted to see if the lot has all been issued in accordance with the storeskeeper's report.

175. Bin Tag.— If the Stores Ledger is kept in the office, the chief stockkeeper must be provided with some means of watching the

movement of his stock, so that he will know when it reaches the minimum limit, at which time a requisition must be prepared to have the stock replenished. The "Bin Tag," Form 53, is the means furnished the storeskeeper for thus keeping track of his stock. This stock record is the simplest form of perpetual-inventory system. The card, as its name indicates, is attached to the bin or container which holds the stock; it may be held in place by means of a tack or kept in a little metal holder attached to the bin for the purpose. The advantage of having the Bin Tag as close to the stock as possible is that by making the record of stock received and issued at the same time that the material is put into or taken out of the bin or other container, the balance shown to be on hand is always up to date. Since the storeskeeper who makes the entries on the Bin Tag has the actual stock right before him, he can detect readily any wide discrepancy between the balance-of-stores shown to be on hand and the physical inventory. At inventory time the balance on hand as shown by the Bin Tag should be reconciled with the physical inventory of the stock and any discrepancies adjusted. Bin tags are usually operated as auxiliary to the Stores Ledger kept in the office. If this is the case, the Stores Ledger usually shows money values as well as quantities. From time to time the balance on hand as shown by the bin tags should be compared with the balances appearing on the Stores-Ledger cards and a reconciliation effected between these two complementary elements of the perpetual-inventory system.

176. Stock Record Showing Quantities Only.— Owing to the nature of the materials used and the various conditions found to exist in different lines of business, several forms of stock records are required, although the governing principle is the same for all articles. Stock records are compiled from purchase orders, from receiving reports, and from requisitions, of which several kinds are used. To prevent errors it is necessary to use much care in compiling records, and frequent verification is essential. A "Stock Record," Form 54, is presented for the purpose of showing the operation of a stock record designed for recording quantities only. A complete description is entered at the top, together with the unit of measure and maximum and minimum limits. Column headings provide for entering information pertaining to purchases, receipts, issues, and balance on hand. This last mentioned item is, of course, the most important, because

it shows when the minimum limit is reached, at which time a new purchase order must be placed. In the case illustrated it will be seen that on January 2, 100 lb. of round rubber gaskets were purchased from the Garlock Packing Co. Delivery was made on January 11. Issues were made from time to time until on January 17 the balance on hand was only 25 lb., at which time a new purchase order was

54

STOCK RECORD

Unit Lb.

Article Gaskets Rubber, Round Max. 100 Min. 25

Date	No.	Vendor	Quant.	Date	No.	Price	Rec'd.	Issued	Bal.	Date	No.	Price	Rec'd.	Issued	Bal.
1917 Jan 2	1	Garlock	100	1917 Jan 11	1	.63	100		100						
" 17	15	"	75	" 12	27	.63		20	80						
				" 14	30	.63		30	50						
				" 17	41	.63		25	25						
				" 18	50	.63		20	5						
				" 20	60	.63	75		80						
				" 25	62	.63		10	70						

FORM 54. STOCK RECORD SHOWING QUANTITIES ONLY

placed for the purpose of replenishing the stock. The column provided for entering the price is for reference when extending the value of stores issued on requisitions. The Stock Record illustrated in Form 54 is suited to the needs of a great many plants.

177. Raw-Stores Record for Lots.— A slight modification of the usual type of Stock Record previously described is illustrated by the "Raw-Stores Record," Form 55, used by a manufacturer of ostrich-feather plumes. The form is designed for keeping track of raw feathers by lot numbers, as illustrated. Reference to the record shows that Lot 1 was received *ex.* S.S. *Africa,* consisting of 100 lb. "Whites" (feathers from male ostriches) at $95.90 a lb. From this lot 10 lb. have been issued to the factory on Job 1. Three lots can be taken care of on one card. The back of the card is printed so that it can be turned over and the record of issues continued until each lot is exhausted. The use of this method makes it an easy matter to

55

RAW STORES RECORD

Description Whites

Date	Ex.	Lot	Quantity	Unit	Price	Amount
	S.S. Africa	1	100	Lbs.	95 90	9 590 00
		2				
		3				

1			2			3		
Date	Job No.	Quantity	Date	Job No.	Quantity	Date	Job No.	Quantity
	1	10						

FORM 55. RAW STORES RECORD

obtain a good check on the physical inventory, because any discrepancy can readily be located against one or more lots.

178. Finished-Goods Stock Record Showing Quantity and Amount.— A "Finished-Goods Stock Record," showing both quan-

56

FINISHED GOODS STOCK RECORD

Description Black French Plume Style No. 1948

Received						Issued					
Date	Job No.	Quantity	Price	√	Amount	Date	Job No.	Quantity	Price	√	Amount
	1-10	10 Dz.	29.73		297.34						

FORM 56. FINISHED GOODS STOCK RECORD

tity and amount columns is illustrated in Form 56. The record shows that 10 dozen black French plumes, style 1948, have been received into stock from the factory on jobs numbered 1 to 10, at a cost of $29.73 a dozen. So far none has been issued. The use of forms containing money-cost columns provides a convenient means for reconciling the balance-of-stores record with the controlling stores account kept in the General Ledger. It is more work to keep a Stores Ledger showing both quantities and cost for each item received and issued than it is to keep a record of quantities only. However, in factories where the materials handled are very valuable, the additional clerical work involved in keeping a Stock Record such as shown in Form 56 is justifiable, as its operation permits of a complete reconciliation with the balance-of-stores shown on the controlling inventory account in the General Ledger.

179. **Stock Record with Paid-Duty Feature.**— The stock record used by a manufacturer of prepared cocoanut is illustrated by Form 57. Attention is called to the "Paid-Duty" feature of this record. On January 1, 50,000 "Select Ruatan" cocoanuts were received *ex.* S.S. *Oceanic* at $25 per thousand, but the duty was paid on only half of them, as shown. The form is designed to record stock receipts and issues by lot numbers. It will be seen that on January 2, 10,000 cocoanuts from Lot 1 were issued to the factory, leaving a balance on hand that cost $1,000. The use of such a record as this has a wide range of application in industries for which the raw material is imported.

180. **Desk Containing Stores Ledger Cards.**— When the Stores Ledger is kept on cards, which is the prevailing practice, the cards should be kept in a special desk containing sunken compartments. When kept in such a desk the cards can be placed within easy reach of the balance-of-stores clerk, while the further introduction of a complete system of guide cards makes it possible to find any Stores-Ledger card wanted almost instantly. The operation of a Stores-Ledger system in a desk constitutes the highest development of stock records.

181. **Records of Small Tools.**— It is necessary to keep a record of the small tools that are issued to mechanics in a plant and that are to be returned to the tool room when no longer required for use. The best system to use is one in which the operatives are each given a ring with, say, 20 small brass or aluminum checks, each bearing the em-

ployee's clock number. Then, when an operative applies to the toolroom clerk for a tool, he leaves one of his checks. The system in the toolroom requires that a 3 by 5 inch manilla envelope containing the description of the tool be made out for each tool in stock. On the

57

STOCK RECORD

ARTICLE *Select Ruatan Cocoanuts*

DATE		LOT	EX S.S.	QUANTITY	UNIT	PRICE	✓	AMOUNT	
19 Jan	1	1	Oceanic	50	M	25.00		1,250	00
		2							
		3							

PAID DUTY

Jan. 1	25 M.				

DATE		DISPOSITION	1	2	3	BALANCE	
Jan	2	Factory	10 M			$1,000	00
		FORWARD					

FORM 57. STOCK RECORD WITH PAID-DUTY FEATURE

front of the envelope is printed the word "IN" and on the back is printed the word "OUT;" both in bold-faced type. These envelopes are filed in accordance with any desired arrangement, but preferably by tool numbers. If each tool is numbered, the tool or "T-number," as it is called, also appears on the tool-record envelope. When a tool is issued to an operative, the envelope containing the corresponding

tool number is opened and the operative's tool check dropped in, after which the envelope is reversed in the file so that the "OUT" side faces front. By this means reference to the tool-record file shows at all times, just what tools are in stock and which ones have been issued to employees. If it is desired to ascertain who has a particular tool, reference to the envelope containing the tool number enables the clerk to find the check bearing the workman's number. When an operative returns a tool to the stockroom, the clerk returns his check. A workman upon leaving the employ of the company where this system is operated must return to the toolroom clerk all his tools and his ring containing a full set of checks, after which the toolroom clerk gives him a tools-clearance slip. This he must present to the paymaster in order to receive his pay for his last week in the employ of the company.

182. **Summary.**— From the foregoing description of perpetual-inventory systems it is seen that the operation of a Stores Ledger is an important function. The Stores Ledger furnishes a means of keeping a check on the physical inventory, on the one hand, and, on the other, records the movement of stock so that when the minimum limit is reached immediate steps can be taken to replenish the stock. The operation of a Stores Ledger furnishes the purchasing agent with useful information regarding the rate of consumption of each item carried in stock. When money values are shown on the subsidiary Stores Ledger, a means is provided for reconciling the perpetual-inventory record with the General Ledger controlling accounts. Taken all in all, the proper operation of a Stores Ledger is of fundamental importance in order to exercise complete control over all material.

Questions on Chapter XIII

1. What is the best method for exercising control over inventories?
2. What is the best plan for arranging the cards in a Stores Ledger?
3. Are card or loose-leaf records best adapted for the Stores Ledger?
4. Under what conditions is it desirable to show money values in addition to quantities on stock records?
5. What is meant by the lot-number system? Give an example of its use.
6. What is a Bin Tag? What are its advantages?
7. Give an illustration showing the operation of a stock record showing quantities only.
8. Illustrate the operation of a stock record suited for keeping track of material by lot numbers.

9. Show how a stock record is operated to give the balance in both quantity and money value.
10. What sort of equipment should be provided for holding stock-record cards?
11. What system is best suited for keeping track of the small tools in a factory?
12. Devise a suitable perpetual-inventory record for use in a newspaper publishing plant. Invoices received from paper mills give the roll numbers and the weight of each roll. When paper is used, the press room reports the roll numbers.
13. Devise a perpetual inventory record to be used by a converter of cotton goods. The converter wants to know (*a*) the stock on hand in the store, (*b*) stock in process at finishing mills, and (*c*) stock in process at grey-goods mills.
14. Devise a stock record for use in a textile jobbing house. Several hundred qualities of fabric are carried, each one of which may be in a half-dozen or more shades. Goods are received from the mill in the piece and sold usually in the piece. Pieces are numbered consecutively.

CHAPTER XIV

PHYSICAL INVENTORIES

183. **Inventory Date.**— It is a recognized part of accounting procedure that a physical inventory be taken at regular intervals, usually at the end of the fiscal year, as a means of closing the books. Most concerns adopt a fiscal year that will end during a period when production is slack, so that the taking of the inventory may interfere as little as possible with business. It is a good plan to notify the factory, considerably in advance of the date when inventory is to be taken, to taper off on production so that as little work as possible will be in process on the day the inventory is taken. Foremen should be required to return to the storeroom all material not needed for orders. Defective and obsolete material should be gone over by a committee appointed for the purpose of deciding what disposition should be made of it. The aim should be to get everything in readiness so that the work of stock-taking may proceed with the least possible delay.

184. **Preliminary Steps.**— At the outset it is necessary to determine just what items should be included in the inventory. As a general rule, it should be the practice to include all raw materials, supplies, tools, patterns, machinery, equipment, furniture and fixtures, work in process, manufactured parts, and finished goods. The physical inventory should be complete, and should cover all those accounts which are usually set up on the balance sheet under the head of inventories, as well as the plant items other than the land, buildings, and permanent fixtures. There are certain steps that can be taken in anticipation of taking the inventory which greatly facilitate the work on the appointed day. It is important to see that everything is properly arranged in a way to permit all material to be counted readily, weighed, or measured as the case may be. It is also important to see that everything is properly identified, so that material can be recorded accurately when the inventory is taken. If a perpetual inventory system is already in operation, the taking of a physical inventory furnishes a means of checking the Stores Ledger balances

against an actual count. If it is desired to install a perpetual-inventory system, it is essential that an initial physical inventory be taken with special care, for the purpose of obtaining correct information which can be used for opening new stock-record cards. Various forms are required for the purpose of taking the inventory, and so a few typical ones will be offered as illustrations and their use explained.

185. **Inventory Tags.**— One of the most satisfactory methods in vogue for taking the inventory makes use of "Inventory Tags," such as those illustrated in Forms 58 and 59. Form 58 is designed to be used for recording stores and equipment, and Form 59 is for work in process. These tags are of the coupon form and are eyeleted so that they can be fastened readily to the various articles to be inventoried in advance of the day when the inventory is to be taken. The tags are numbered serially, and a block of them is given to each foreman, stock clerk, or other person in charge of inventorying a section of the plant. Provision is made for recording full particulars regarding each article or group of articles inventoried. When all the articles in a section have been tagged, the person in charge should notify the head of the inventory committee that all is in readiness. When all sections have been reported in readiness, notice is given to detach the coupons on the dotted line and forward them to the office. They are then checked up to see that all numbers used have been reported. If all coupons have been received, word is given to the factory to resume operations. The tags should then be sorted according to any desired classification and the final inventory figures prepared.

186. **Inventory of Supplies.**— Under certain conditions it is found desirable to make use of "Inventory Sheets," such as the one shown in Form 60. In case such sheets are used, it is customary to have those who take the inventory work in teams of two, one calling off the names of articles and quantities, while the other writes down the data. Provision has to be made for entering the prices. If the articles inventoried have been bought from some vendor, this is usually done in the purchasing department. But if the articles were made in the factory, pricing is usually done by the cost department. After the sheets are priced, they have to be extended and footed, operations which are greatly accelerated by using a comptometer, the use of which will be explained in a subsequent chapter.

58

THE A. B. CO., NEW YORK
INVENTORY DEC. 31, 19 -
NOTE: EVERY NUMBER MUST BE ACCOUNTED FOR
7524

75.24
THE A.B. CO. NEW YORK
INVENTORY DEC. 31, 19 -

STORES AND EQUIPMENT
CLASSIFICATION
ITEM
DRAWING NO.
MATERIAL
SIZE
PRICE UNIT
QUANTITY
VALUE $

LOCATION
FLOOR SECTION
DEPT. NO. BIN NO.
COUNTED BY WRITTEN BY
PRICED BY ENTERED BY

OVER.

59

THE A.B. CO., NEW YORK
INVENTORY DEC. 31, 19
NOTE: EVERY NUMBER MUST BE ACCOUNTED FOR
3002

3002
THE A.B. CO. NEW YORK
INVENTORY DEC. 31, 19

WORK IN PROCESS
CLASSIFICATION
ITEM
DRAWING NO.
QUANTITY
LABOR COST PER 100
TOTAL LABOR COST
MATERIAL COST PER 100
TOTAL MATERIAL COST
OVERHEAD COST
VALUE $

PROD. ORD. NO.
NEXT OPER'N. TO BE DONE
INVENTORIED BY

FORMS 58 AND 59. INVENTORY TAGS

187. Inventory Sheet, with Coupon.— In order to detect mistakes in making extensions, an inventory sheet with a coupon, such

60

TAKEN BY
PRICED BY
EXTENDED BY

INVENTORY OF SUPPLIES

No.
PAGE

ON HAND 191 AT STORE

	UNIT	QUANTITY	DESCRIPTION	PRICE	AMOUNT	TOTAL
			AMOUNT CARRIED FORWARD			

FORM 60. INVENTORY OF SUPPLIES SHEET

as that illustrated in Form 61, is sometimes used. The method of procedure is to write up the inventory on the body of the form and then to give the sheets to comptometer operators who make all exten-

sions on the coupon. After the extensions have thus been made, the coupons are detached and filed by sheet number. Extensions are again made on the body of the sheet, care being taken to see that the same operators who made them the first time do not make them the second time. Afterwards the totals are compared with the results

61

INVENTORY SHEET

Called by	Extended by	Goods in Process	Sheet No.		Sheet No.
Listed by	Examined by		Page No.		Page No.
Priced by	Classification	Date	Dept.		Dept.

	Tag Number	Part Number	Name of Part	Material Quantity	Material Price	Material Amount	Labor Price	Labor Amount	Grand Total	Material Amount	Labor Amount	Grand Total
			Amounts Brought Forward									
			Labor Sub-Total									
			Add % Overhead Expense									
			Amounts Carried For'd									

Form 61. Inventory Sheet with Coupon

shown on the coupons. If the footings on both the body and the coupon agree, the latter is destroyed, but if there is a difference, it must be located and the correct total entered on the body of the inventory sheet. Form 61 is designed for recording goods in process, but the plan of using an inventory sheet with a coupon can also be adapted for inventorying supplies or equipment.

188. Inventory of Sole Leather in Process.— In every industry there are certain conditions that must be considered when designing the inventory forms. The sheet used for taking the inventory of work in process in a sole-leather tannery is shown in Form 62. It will be noticed that provision is made for entering each lot number, together with the number of sides and pounds in process. Since the sole leather in process has labor and indirect expense charged against it, these items of cost must be included as shown. The sum of the material, labor, and expense gives the total cost. The existing conditions in each industry must be studied carefully with a view to de-

signing inventory forms suited to meet the needs of the case. The forms presented in this chapter are suggestive of what is required in inventory records, and with slight modifications, depending upon local conditions, they can be adapted to meet the conditions found in any plant.

62

INVENTORY OF SOLE LEATHER IN PROCESS

Date..... 19.....

	Lot No.	Number of Sides	Pounds	Distribution Total	Distribution Material	Distribution Labor	Distribution Ind. Exp.

Taken by..... Checked by.....

Form 62. Inventory of Sole Leather in Process

189. Inventory Instructions.— In order that the work of taking the physical inventory may proceed with the least possible loss of time or misunderstanding, it is necessary that complete inventory instructions be issued. The instructions are usually prepared by the inventory committee and read somewhat as follows:

Inventory Instructions

December 1, 192—

The works of the C. D. Engineering Company will be closed for the purpose of taking the inventory from December 29, 192—, to January 2, 192—, inclusive.

Inventory forms will be issued to those in charge of taking the inventory in each section. Every lot of material is to be counted or weighed, and entered on the proper form.

Each foreman, storeskeeper, tool-room clerk, or other assistant will have charge of the section of the plant which comes under his daily supervision. These will be assisted by employees from the shop and office who are especially assigned to the work of taking the inventory. It is essential that

these instructions be carefully studied so that each employee will be familiar with his particular duties.

It is of the utmost importance that all machinery, fixtures, and equipment be properly numbered so that they can be identified readily.

Notice is hereby given to all superintendents, foremen, and assistants to complete all work possible in their departments prior to the taking of the inventory so as to have as little as possible in process on December 30, 192—. All material remaining on hand in the departments should be sorted by kinds and arranged ready for counting or weighing.

The chief inspector is instructed to complete the inspection work on all shop products made up to December 29, 192—, so that all completed work may be in stock ready for inventorying December 30, 192—.

The production-order department is instructed to issue the minimum number of orders to the shop on the three days preceding December 30, 192—, so as to enable the factory to taper off on production.

Storeskeepers are instructed to see that all Bin Tags [Form 48] contain the correct balance on hand at the close of business December 29, 192—. This is a necessary part of the inventory procedure in order to minimize the work of inventorying material carried in storerooms.

Foremen and assistants must give a complete description of each lot in process of manufacture, including the next operation to be done. The work-in-process inventory must show the number of pieces done up to any given operation.

All goods in process which are imperfect but which can be repaired must be kept separate and entered on a special inventory sheet headed "defective work."

Obsolete stock and condemned articles must be scrapped and entered on a separate inventory sheet together with other items of scrap material so that they can be disposed of.

In case material cannot be weighed or counted for any reason a careful estimate of its value must be made by the superintendent.

All materials invoiced prior to January 1, 192—, but not unloaded until after January 1, 192—, should be inventoried from the invoice and pains taken to keep such goods separate from the regular stock.

In case material has been received from vendors but not invoiced at the time of taking the inventory, such material should not be included in the inventory.

As soon as the inventory in any department has been completed the foreman, storeskeeper, tool-room clerk, or other person in charge should report the fact to the Inventory Committee.

SIGNED.....
.....
.....
Inventory Committee.

190. Pricing the Inventory.— Arrangements should be made to have the inventory priced as soon as it has been taken. The raw material and supplies should be priced by the purchasing department

on the basis of the prices obtained from the source of supply, or by the stock-record clerks from information carried on the perpetual inventory cards. Any tools, fixtures, and jigs made in the shop should be priced by the cost-accounting department, while all shop equipment purchased outside should be priced by the accounting department from information contained on the equipment records. It is necessary to calculate the cost of the jobs in process by adding together the material, labor, and overhead expense chargeable to each; this should be done by the cost department. Manufactured parts should be priced at cost of production as shown by the cost sheets. After all items on the inventory have been priced and extended, it is necessary to recapitulate them according to General Ledger account classifications. When all of the work has been completed, the inventory committee should certify the figures to the chief accountant or auditor, who can then proceed to close the books.

191. Summary.— Considerable work is involved in taking a physical inventory in order to provide that every step shall proceed without loss of time. The physical inventory is needed, on the one hand, as a means of detecting inaccuracies in the stores accounts, and, on the other, as a means of closing the books properly at the close of an accounting period. The inventory forms and instructions presented in this chapter are intended as a guide to anyone who has to take charge of a physical inventory.

Questions on Chapter XIV

1. What is the purpose of taking a physical inventory of stock?
2. What preliminary steps should be taken in anticipation of taking a physical inventory?
3. How are inventory tags used?
4. How is an inventory sheet operated?
5. How can errors in extensions on the inventory be guarded against?
6. In issuing inventory instructions what are some of the important points to be kept in mind?
7. Who should price the inventory?
8. Refer to the picture of the Square-Turn Farm Tractor shown on page 81, and devise an inventory sheet for use in listing tractors in process of manufacture on the erecting floor.

CHAPTER XV

REBATES, SHRINKAGES, AND MARGINS OF ERROR IN CALCULATING MATERIAL COSTS PECULIAR TO SPECIAL INDUSTRIES

192. **Cost Formula for Material.**— In figuring the cost of material the inward freight charge must be added to the invoice price in order to find the gross price. In certain cases the value of waste and scrap that can be salvaged is deducted from the gross price so as to obtain the net cost of material. Under the conditions found in a great many industries no special difficulty is experienced in calculating the unit cost of material used in the product.

In some industries, however, the raw materials used are subject to frequent changes in weight due to atmospheric conditions, which cause either evaporation, which results in decrease in weight, or absorption of moisture, which results in a gain in weight. Animal products are invariably subject to such variations, which, of course, affect the unit price at which the raw material must be figured. During the process of manufacture there are likely to be waste, spoilage, defective workmanship, and by-products to be accounted for. The most common problems encountered in calculating material cost will be explained somewhat in detail.

193. **Cost of Raw Material.**— The simplest case of material-cost calculation is that in which the vendor fixes a price that includes all transportation charges necessary to make delivery to the customer's plant. In this case it is a simple matter to price the raw material or parts used on a job at the invoice price. If the quotation of the vendor is made f. o. b. (free on board) the point of shipment, the best plan is to ask the vendor to prepay the freight and to include it with the price of the goods on the invoice. It is then an easy matter to calculate the unit cost of the goods purchased, including the charge for freight. Variations may occur and cartage charges may arise, but in all cases the total cost of material should include all outlays made until it reaches the door of the plant.

194. **Containers and Coverings.**— Many kinds of raw material are packed in containers or are protected by bagging or other coverings, the costs of which are included in the prices of the goods. Containers such as barrels, boxes, casks, crates, and also coverings such as bags and bagging, however, have a usable or salable value which is an offset to the price paid. Hence, in arriving at the cost of manufacturing, it is necessary to deduct the value of all such containers and coverings. For example, manufacturers of fancy crackers and cookies purchase large quantities of sugar in barrels which are later used either for packing the finished product or are sold. When sold, they are frequently returned to the vendors and credit at the market value for barrels is allowed. It is apparent, therefore, that the value of barrels is an offset to the gross cost of sugar. Other examples will come readily to mind.

195. **Scraps and Cuttings.**— The correct practice is to charge the factory for all material issued from the storeroom. During the process of manufacture, scraps and cuttings frequently result from the operations of stamping, pressing, trimming, and cutting. These scraps and cuttings have a market value which is an offset to the original charge to the factory. It is, therefore, the best practice to keep separate the scraps and cuttings from each lot, process, or job, in order to be able to make the appropriate deduction from the original charge.

196. **Refinings.**— In gold and silver jewelry manufacturing establishments it is the custom to save all filings and floor sweepings and when several barrels have been collected to send them to a refiner. There all of the gold and silver is reclaimed, and from its market value the refiner deducts his charge and remits the balance to the jewelry manufacturer. It is, of course, apparent that the return from the refinery cannot be allocated to any particular job; hence, it is customary to credit the amount received to the general factory Overhead Expense account.

197. **Invisible Waste.**— All waste cannot be readily ascertained, for there are some conditions under which an invisible waste is constantly going on. It is apparent that if 100,000 lb. of cotton are put into a mill and the weight of fabric produced from this quantity of raw cotton is 90,000 lb. and the waste products total 2,000 lb. the invisible waste amounts to 8,000 lb. In every textile mill there is

always invisible waste that must be taken into account when calculating the cost of material. In the foregoing hypothetical case the pounds of invisible waste divided by the pounds shipped (8,000 ÷ 90,000) gives 8.88 per cent, so that a pound of fabric sold contains only 91.12 per cent of the fibre actually consumed. This means that to the cost of material in every pound of goods shipped 8.88 per cent must be added in order to find the amount chargeable to any particular fabric to cover invisible waste. Suppose, for example, that a cotton bed-spread weighs four pounds when finished and is made of cotton costing $0.20 per pound. The calculation of the cost of material used would be $0.80 : X :: 91.12 : 100. This gives $0.8779. Of course, the figures will vary with the various rates of shrinkage in different cases. There are any number of industries in which the problem of invisible waste is encountered, and it is very important that proper allowance be made for it when figuring costs.

198. Waste in Cutting Lumber.— When lumber is purchased for use in a wood-working factory, it is usual to record its cost, including inward freight, expense of kiln drying and so on, at a certain price per 1,000 ft., board measure, a board foot being 12″ x 12″ x 1″. In a furniture factory, for example, the lumber is issued from the storehouse or kiln to the mill at the rate per 1,000 board ft. at which it has been priced. Specifications regarding the pieces wanted for the manufacture of, say, 500 Martha Washington sewing tables are followed by the sawyer in cutting the lumber into the required pieces. It is necessary to figure the number of 1,000 ft., board measure, in the pieces that have been cut for the lot of 500 tables. The board measure in the pieces produced will, of course, be considerably less than that in the original lot of lumber. It is, therefore, necessary to divide the number of 1,000 ft., board measure, in the pieces cut into the original cost of the lot of lumber issued to the mill (any pieces returned to the stockroom having been deducted) in order to get a new price per 1,000 ft., board measure, for the pieces. Thus, if the lumber cost $75 per 1,000 ft., it is likely that the new price will be $110 or more per 1,000 ft., due to the waste in sawing and the scraps left.

199. By-Products.— Many operations result in by-products that can be used for the purpose of manufacturing a salable commodity. The question often arises how to apportion the cost of a unit of orig-

inal raw material between the portion used in producing the main commodity of the plant and that worked up into a by-product. One plan is to regard the by-product material as merely salvage. Then, after deducting all outlays incurred in making and selling the by-product, the surplus income is called the "net salvage" and is deducted from the original cost of the raw material, thereby somewhat reducing the material cost for the main product of the factory. For example, a manufacturer of millwork used all scraps for making wooden toys such as Noah's arks, and did not consider that the scraps cost anything. The cost of making the toys was separately accounted for, and the profit on the operation of the toy department was used as an offset to the original cost of the lumber put into millwork. This method is followed also by tanners of calfskins used for upper shoe leather when splits are taken off from the flesh side. These splits can be turned into leather suitable for the manufacture of small novelties, and the profit on the sale of split leather is considered a deduction from the original cost of the calf skins used for making grain leather. The beef-packing industry furnishes a good example of the problem of by-products and their effect on costs. The cost of dressed beef in New York is calculated as follows. The gross cost of a lot of beef is first determined by adding together the amount paid for the live cattle in the Union Stock Yards at Chicago, the buying department's charges, and the freight to New York. From this total is deducted the amount received from the sale of the raw hides, fat, entrails, blood, brains, tails, and skulls. The balance remaining is divided by the number of pounds of dressed beef in the lot in order to find the cost per pound of dressed beef.

200. Yield.— In some industries it is common to speak of the yield obtained from the raw material used. The yield may be referred to as the number of pounds produced for each 100 lb. of raw material put into process, or one may speak of the percentage of yield, meaning the percentage of original stock found in the product. Thus, in the tanning of green ox hides for the purpose of making sole leather, there is considerable visible loss in weight due to the removal of the hair and some invisible waste due to the evaporation of the moisture as a result of the tanning and drying processes. It usually happens that for every 100 lb. of green hides put into process, only about 80 lb. of tanned sole leather is produced; the percentage of yield is, there-

fore, 80. This, of course, has a direct bearing in calculating the cost of raw hide stock used. In this particular case the hair removed is sold, and the sum realized acts as a small offset to the cost. There are many instances where the percentage of yield must be calculated to find the cost of material, especially in those industries in which animal products are consumed.

201. **Junk Department Expense.**— In many plants junk, scraps, and waste are all sent to a department equipped with baling machines, where the material is put into salable condition. Here the stock to be sold has to be sorted out, to obtain the best market price on the various grades. The expense of operating the junk department should be paid out of the proceeds from the sale of waste material. The difference between the sales of junk and the expense of operating the department is the figure to be used in crediting the factory cost for waste materials.

202. **Gain in Weight.**— In some manufacturing processes weight is intentionally added to the material. This results not only in changing the weight per unit of the product, but also in altering the cost price. Thus, in the silk industry it is the practice purposely to weight black silk by using as heavy dyes as possible. Since the dyestuffs cost less per pound than raw silk, the result of weighting is to reduce the average price per pound of all material in the fabric. When prepared cocoanut, generally known as "desiccated," "shred," "macaroon," or "thread," is manufactured, it is the practice to mix sugar, glucose, and salt with the raw meat, and inasmuch as these ingredients cost less per pound than the cocoanut meat, the result is a reduction in the pound price of the dried meat. Pig lead absorbs oxygen from the air when being converted into white lead paint. This reduces the cost of material in a unit of the product.

203. **Loss and Gain on Estimates.**— In some industries the pieces required for the manufacture of the product are cut out of leather or cloth by the use of patterns. When the sample line is prepared, it is the custom to lay out the patterns on the material and ascertain the quantity required to produce a unit of the product. This is done primarily as a means of estimating the cost of material in a unit of product and also as a guide in establishing the lowest possible unit selling prices. Because of the operating conditions that exist in a good many plants and the clerical expense involved in keeping detailed records, it is the practice to make use of these cost estimates of material in figuring the cost of production. When this is done, it is necessary to employ a check on the material estimates, in order to bring to light any discrepancies between the estimated quantities adopted for convenience and that actually consumed. The method of procedure is to keep a record of the actual total quantity of material used during a given period and to make a comparison between this and the sum of the arbitrary units of material in the products made out of that total stock. If the actual quantity of material consumed is more than the quantity previously estimated, the excess material used is a loss on the estimate of material, while the consumption of less than the estimated material results in a gain over the estimates. The loss or gain on material estimates is a debit or credit, as the case may be, to the Loss and Gain on Estimates account.

There is still another feature of the Loss and Gain on Estimates account that has not been mentioned. That is, the variation between the unit price estimated to be paid for the material used and the actual price paid for the material consumed. If the material used costs more per unit than the estimated price, a loss is sustained on this account. If the price actually paid is less than that estimated to be required to purchase the material, a gain over the estimate results. The loss or gain sustained on account of price variations between the current prices paid and the estimated price is a charge or credit, as the case may be, to the Loss and Gain on Estimates account.

Wherever predetermined costs are used, it is necessary to employ a Loss and Gain on Estimates account for the purpose of controlling the adjustments on material. Thus, for example, in the shoe, leather-glove, pocketbook, and leather-novelty industries it is the practice to estimate the grade of material to be used for each style carried in the sample line, as well as the unit price to be paid. In the shoe business the grade of calfskin and the number of square feet required to be cut up for the upper leather in each pair of shoes of the average size, are estimated at the beginning of the season. As the various lots of leather are cut, a record of the feetage used is kept and a comparison made between the yield and the estimated feetage required. The feet actually used are extended at the price paid in order to find the proper charge to the factory, and the feet estimated to be required are priced at the estimated cost per foot. The difference in amount be-

tween the actual consumption and the estimated requirements is a charge or credit, as the case may be, to the Loss and Gain on Estimates account.

204. **Sorting and Grading Material.**—It often happens that after material has been purchased, it has to be sorted and graded into different classes suitable for the manufacture of various qualities of the product. After the grading process has been completed, it is necessary to attach a new scale of values to the various classes of material. It is obvious that stock that is suitable for manufacture into a high-grade article is worth more per unit of measure than stock suitable only for manufacture into average or inferior grades. Thus, when a fleece of wool from a sheep's back is purchased, it contains various qualities of wool. The first operation is known as sorting. The wool from the shoulders is put into one basket, that from the neck and head into another basket, that from the sides into still another, and so on. After the sorting operation has been completed, there are several baskets, each of which contains wool of a different grade and worth a different price for the purpose of manufacturing yarn. This grading system holds for all materials purchased in forms that require and permit subdivision into lots of various qualities, grades, or uses.

205. **Cost of Material Mined or Quarried.**— In case a mine is leased or operated on a royalty basis, the royalty paid to the owner of the mine on each ton of ore extracted must be added to the cost of extraction in figuring the cost of material. When a straight royalty is paid, there is no doubt as to the charge that should be made on account of depleting the owner's natural resource. However, if mines, quarries, or timber lands are owned by the operator himself, it is not an easy matter to arrive at the charge that should be made to cover the exhaustion of the natural resources. In such a case the owner should debit the enterprise and credit his personal or firm account just as though he were charging someone else a royalty for the use of his mine or timber land.

206. **Take-Up in Weaving.**— When cloth is woven, the loom interlaces the filling yarn with the warp yarn. The operations are shedding, picking, and beating up. The first has to do with raising and depressing certain of the warp yarns (warp yarns run lengthwise of the cloth) so that a shed is formed through which the shuttle

containing the filling yarn is driven by the picker stick. Each time the shuttle makes its passage across the loom it adds one thread, or one pick, as it is called, to the fabric. Afterwards the pick has to be beaten up into place against those previously made in order to form a compact fabric. The cycle of operations is then repeated until the design has been woven into the fabric. During the weaving process the warp yarn is stretched tight in the loom while it unwinds from the rear beam, and the woven fabric is wound up on the forward beam. The result of interlacing the filling yarn with the warp yarn is to cause a certain amount of take-up when the fabric is removed from the loom, due to the fact that the warp yarns are no longer straight but pass over and under the filling yarn in the order called for by the design. This means that to produce 100 yds. of woven goods it is necessary to start with a warp of say 105 yards in length. The take-up in weaving is, therefore, an important factor to be considered when calculating the quantity of yarn required to manufacture a given length of cloth.

207. **Take-Up in Twisting Rope.**— Another example of take-up is found in twisting together strands of sisal or hemp yarn in rope and cordage making. Rope is ordinarily made of three strands, each containing many yarns, by twisting the strands together. When twisted, the strands follow the direction of a spiral, so that in order to make a rope 100 ft. long it may take three strands each 125 ft. long, the take-up amounting to 20 per cent of the original length of the strands.

208. **Mixtures.**— It frequently happens that several kinds of raw material have to be mixed together in order to obtain the combination required for the manufacture of a commodity. When this is the case, it is customary to use a formula which has to be followed in mixing the ingredients. Thus, for example, in a drug laboratory standard formulae are followed in making the various preparations. When a production order is issued to the laboratory to make a certain quantity of a standard preparation, the chemist writes in a book the list of ingredients used and the quantity of each, together with the *number* of bottles, jars, tubes, and so on, produced. It is the duty of the stock-record clerk to use the chemist's reports as the basis for making the proper credits on the issued side of the Stock Record and for calculating the unit price of the mixtures produced.

Vendors of fancy packages containing candied citron, lemon and orange peel, dates, figs, and confections follow a formula in putting up the packages. Since the selling price is based on the assumption that these goods will be packed in accordance with the different formulæ used and that the cost will vary accordingly, it is of the utmost importance that the cost of material in each lot mixed be calculated as a check on the use of too large proportions of expensive ingredients. Vendors of mixed nuts, for example, should keep the cost of each of the various mixtures sold.

209. Cloth Organizations.— The operating conditions that prevail in some industries make it impossible to charge the stock issued from the storehouse against any particular job or style number. However, if the only satisfactory cost system is one that provides for ascertaining the cost of production by jobs or style numbers, it is of fundamental importance that the cost of material used in each unit of the finished product be accurately calculated. This can be done frequently from a knowledge of the structure of the product, as shown in the specifications which are prepared by the designer or draftsman as a guide to the factory. When the specifications are available as a basis for calculating the quantity of material used, this is the best procedure. If this is done, raw material is drawn out from the storehouse on requisitions and a charge made to the factory, but not to any particular style or job. For example, in a weaving mill it is impossible to draw the exact amount of yarn needed for each warp and the filling required for each cut. However, the cloth organizations, as the specifications showing the construction of the cloth are called, furnish the necessary basis for calculating the cost of yarn required to make any fabric. Thus, if there are eight kinds of yarn in the warp, the cloth organization shows the exact weight of each kind of yarn required in a warp of a certain length, of, say, 900 yds. If there are three kinds of yarn in the filling, the cloth organization shows the exact quantity of each required. All that is necessary to do, therefore, in order to calculate the material cost, is to extend the weight of each kind of yarn called for by the cloth organization by the price per pound. At the end of an accounting period, when inventories are taken and the books closed, the amount of yarn consumed should, of course, equal the total amount charged to each style of fabric produced as per the analysis of the cloth organizations.

210. Textile Calculations.— In the textile industry the system in vogue for numbering yarns is what is known as the "fixed-weight and fixed-count" system. Thus, for example, a No. 1 cotton yarn contains 840 yds. to a hank, weighing one pound. A No. 2 cotton yarn contains two 840-yd. hanks to the pound; a No. 30 yarn, 30 of the 840-yd. hanks to the pound; and so on. From this it will readily be seen that any manufacturing process through which the yarn goes that results in changing the weight of the yarn in an 840-yd. hank results in changing the count. The problems that arise in the textile industry in connection with counts of the different numbers of yarn used and some of the more important calculations will be presented in the next chapter.

211. Summary.— From the foregoing references to the various conditions existing in different industries the reader will see that there are many calculations required properly to record the cost of material used in the product. The next chapter will be devoted to the presentation of a few typical material-cost calculations.

Questions on Chapter XV

1. Should transportation charges be included in the cost of material?
2. How should the salvage value of containers be accounted for? Give an example.
3. How should the salvage value of scrap or cuttings be handled? Give an example.
4. What is the best method for handling the returns from the sale of refinings in a jewelry factory?
5. What is the best plan for handling cotton waste in a spinning mill?
6. How should cocoanut shells which are burned as fuel be handled in the cost accounts?
7. What is meant by invisible waste in a factory? Give an example.
8. What effect does invisible waste have on the cost of materials?
9. How is waste in cutting lumber applied to the cost of the product in a furniture factory?
10. How should the profit on the sale of a by-product be handled? Give an example.
11. What is meant by "yield"? If 100 lb. of raw silk produces 96 lb. of Georgette crêpe, what is the yield?
12. How should defective work be handled? What is done with the scrap value of the defective part?
13. When material gains in weight while undergoing some manufacturing process what effect does it have on the cost? Give an example.
14. What is meant by loss or gain on estimates? Give an example.

15. What effect does sorting and grading have on the unit cost of material? Give an example.
16. How is the cost of material calculated in the extractive industries, such as mining and quarrying? Give an example.
17. How is the cost of timber calculated when cut from forest lands?
18. What is meant by "take-up" in weaving cloth? How does it affect the quantity of yarn required for manufacturing cloth? What effect does "take-up" in twisting have on the length of the strands required for making rope?
19. What is the practice followed in figuring the cost of a mixture when made from several kinds of material? Give an example.
20. What use is made of specifications for the purpose of calculating material cost? Give an example.
21. What is meant by the fixed weight and fixed count system in the textile industry? Give an example.
22. How much must the advertising rate per line be increased to cover the additional cost of paper used, for each increase of 10,000 in the circulation of a newspaper, when there are eight 300-line columns to a page, and news-print paper costs $0.088 per lb.? It takes on an average 130 lb. of news-print paper to produce 1,000 papers on an 8-page basis.
23. Suggest a basis for apportioning the cost of a lot of 100 oriental rugs for which a total of $5,500 was paid, the rugs being sorted according to selling prices as follows:

Number of Rugs	Selling Price Each	Number of Rugs	Selling Price Each
20	$ 50	10	$150
15	60	5	200
10	70	4	250
10	80	3	300
10	90	2	400
10	100	1	500

CHAPTER XVI

COST ARITHMETIC CONNECTED WITH MATERIAL EXPENDITURES

212. Need for Accurate Data Regarding Material.— In order to illustrate some of the calculations required in connection with figuring the cost of material, reference will be made to a few specific examples taken from several industries and these may suggest methods of handling the material-cost problem under a variety of conditions. The calculation of the cost of material used on a job or in a particular manufacturing process does not involve the use of higher mathematics. What is required is that accurate data be available as a basis for computation. After the facts are obtained, the calculation of the material cost is a simple matter. In actual practice the great difficulty is rather one of obtaining correct data than of making the calculation. The first of the problems that will be presented has to do with the grading of material.

213. Grading Material.—It often happens that material has to be graded. The grading process may take place when the material is received or after some manufacturing process. It thus comes about that material purchased at an average price per unit has to be repriced according to the different grades of material into which the lot is sorted. The determining factor which governs the grading process is the class of goods that can be produced. The material in a lot that is best suited for producing the highest grade of product is obviously the most valuable and should be priced at a higher figure than that which is only suitable for manufacturing into inferior articles. In order to explain the method of repricing material which has been graded, the plan followed in an ostrich-plume factory will be explained.

It should be understood at the outset that raw ostrich feathers are purchased in lots at various prices, depending upon the general character of the feathers. Feathers from male birds are, as a rule, worth more than those from female ostriches. It is not uncommon for the

raw feathers to sell at auction for $100 a pound or more. After the feathers are received by the manufacturer, they have to be graded or selected. The process consists in selecting the feathers according to the quality of the plume they can be made into. Thus, one feather may be suitable for the top of a French plume which sells for $5,

63 CONVERSION FACTORS

Style No.	Top	Middle	Under
1012	41	37	37
1115	43	43	37
1218	46	45	37
1321	59	52	38
1424	63	54	43
1527	69	62	47
1630	68	64	47
1736	70	65	52
1845	82	68	64
1948	75	71	54
2060	83	72	64
2172	100	83	72
2284	110	88	75
3024	59	53	43
3130	70	64	52
4024	52	51	41
4130	61	55	45
4236	72	64	54
4360	98	77	66
50110	115	100	85

FORM 63. TABLE OF CONVERSION FACTORS

while another may be adapted for making the under-feather of a $12 plume. In this connection it should be understood that a French plume is made of three feathers, known as top-, middle-, and under-feathers, which are superimposed one on top of the other. We will now proceed to take up the method of calculating the cost of the feathers after the grading process.

214. **Conversion Factors.**— The first step is to make out a table of "Conversion Factors," such as shown in Form 63. Regarding

each graded or selected group as a standard lot, weights are assigned to each corresponding to their importance as part of the final product, while money values are assigned on the basis of the money value of the material in the final product. It will be noticed that the first column is headed "Style No." The last two figures in the style number indicate the selling price of the finished plume. Thus a 2172 plume is one which sells for $72 a dozen. After the feathers in a lot have all been selected, the top for a 2172 plume is given a weight of 100. If the same feather is suitable for making the middle of a 50110 plume, which sells for $110 a dozen, it is weighted at 100 for that purpose. Now if a feather is a top for a 2060 plume, the problem is to assign it a proper weight comparable with the weight assigned to the lots for the 2172 plume. If the top of a plume selling for $72 a dozen is weighted at 100, it is apparent, using the method of proportion, that the top for a plume selling for $60 a dozen should be weighted at approximately 83. If the same feather is suitable for making the middle of the 2172 style, it should be weighted at 83 in that position. Unless there are reasons to the contrary, the selling price forms the best guide in attaching weights to be used as conversion factors when repricing a commodity after the grading process.

215. **Cost of Dressed Goods.**— The next step is to figure the new prices on the lot of 1,684 feathers which have been divided into 33 different grades. The original lot cost $996.43. The method of calculation is shown in Form 64. The first step is to arrange the quantity of each grade opposite the number or conversion factor, as shown. Then the two are multiplied together and the products in the third column footed, which gives the total shown, 102,736. In order to reduce this figure to $996.43, the cost of the lot, it is necessary to multiply each item in the third column by $0.0097, the quotient of $996.43 divided by 102,736. This gives the amounts shown in the fifth column, the footing of which is $996.43. Now it is an easy matter to ascertain the cost of each feather by dividing the items in the amount column by the corresponding number of feathers in the quantity column. The cost of the first feather is thus seen to be $0.36.

From the information contained in the foregoing table it is an easy matter to prepare a statement showing the cost of the tops, middles, and unders for each style of plume, as shown in Form 65.

Thus, for the 1012 style, the cost of the top is $0.40, corresponding to factor 41; the cost of the middle $0.36, corresponding to factor 37; and so on. The cost of the top-, middle-, and under-feather for the 1012 style aggregates $1.12, while for a 2172 plume the cost of the top-, middle-, and under-feather aggregates $2.48.

"COST OF DRESSED GOODS

DATE LOT NO. JOB NO.

FACTOR	QUANTITY	FAC. x QUANT.	MULTIPLIER	AMOUNT	COST EA.
37	13	481	$.0097	$ 4.66	$ .36
38	16	608		5.89	.37
41	25	1,025		9.94	.40
43	99	4,257		41.29	.42
45	125	5625		54.56	.44
46	62	2852		27.66	.45
47	10	470		4.56	.46
51	16	816		7.91	.49
52	36	1,872		18.15	.50
53	61	3,233		31.36	.51
54	27	1,458		14.14	.52
55	32	1,760		17.07	.53
59	67	3953		38.34	.57
61	100	6,100		59.17	.59
62	86	5332		51.72	.60
63	26	1,638		15.88	.61
64	332	21,248		206.10	.62
66	27	1,782		17.28	.64
68	111	7,548		73.21	.66
69	77	5313		51.53	.67
70	70	4,900		47.53	.68
71	74	5254		50.96	.69
72	104	7,488		72.63	.70
75	8	600		5.82	.73
77	6	462		4.48	.75
82	12	984		9.54	.80
83	18	1,494		14.49	.81
85	10	850		8.24	.82
88	9	792		7.68	.86
98	12	1,176		11.40	.95
100	7	700		6.79	.97
110	5	550		5.33	1.06
115	1	115		$ 1.12	1.12
	7,684	182,736		936.43	

FORM 64. COST OF DRESSED GOODS CALCULATION SHEET

216. **Repricing Graded Material.**— The material which has been graded is put into stock at the new prices and issued to the factory at the new values. Then when a cost is figured, the grade of material is taken into consideration. If this were not done, it would be necessary to make use of average costs, which would result in penalizing all jobs made from material below the average value, and in favoring the cost of all articles made from material above the average value.

The principles outlined above and the methods suggested have a wide range of application. For example, in a Panama-hat factory the bodies have to be graded according to the quality of hat which they will produce. In a sole-leather tannery the sides of leather are frequently cut up into backs, bellies, shoulders, heads, and so on, each of which has a different commercial value per pound although cut from sides costing the same average price per pound. Calfskins after be-

"COST OF TOPS MIDDLES AND UNDERS

DATE LOT NO. JOB NO.

STYLE NO	COST EACH			FACTOR		
	TOP	MIDDLE	UNDER	TOP	MIDDLE	UNDER
1012	$.40	$.36	$.36	41	37	37
1115	42	42	36	43	43	37
1218	45	44	36	46	45	37
1321	57	50	37	59	52	38
1424	61	52	42	63	54	43
1527	67	60	46	69	62	47
1630	66	62	46	68	64	47
1736	68	64	50	70	66	52
1845	80	66	62	82	68	64
1948	73	69	52	75	71	54
2060	81	70	62	83	72	64
2172	97	81	70	100	83	72
2284	106	86	73	110	88	75
3024	57	51	42	59	53	43
3130	68	62	50	70	64	52
4024	50	49	40	52	51	41
4130	59	53	44	61	55	45
4236	70	62	52	72	64	54
4360	95	75	64	98	77	66
50110	112	97	82	115	100	85

FORM 65. TABLE SHOWING COST OF TOPS, MIDDLES AND UNDERS

ing made into patent leather have to be graded according to the prices at which they will sell, and so on. From the foregoing it will be seen that this principle of repricing material that has been graded is a necessary part of the procedure if accurate costs are to be obtained.

217. **Alligation.**— It is frequently desirable to mix several differently priced stocks together in such a way as to obtain a mixture that will cost a certain amount per pound. The calculation required to determine the proportion of each priced stock that must be put into the mixture is known as "alligation." Thus, for example, the problem may be to determine in what proportions wool costing $0.60, $0.80, $1.10, and $1.20 per pound, respectively, should be mixed to-

gether to give a mixture costing $1.00 a pound. The method of calculation is as follows:

Average Cost per Pound	Original Cost per Pound	Loss or Gain per Pound When Sold for $1.00	Pounds Required to Gain $1.00	Pounds Required to Lose $1.00
$1.00	$0.60	+ $0.40	2½	
	0.80	+ 0.20	5	
	1.10	— 0.10		10
	1.20	— 0.20		5

2½	lb.	@ $0.60 =	$ 1.50
5	lb.	@ 0.80 =	4.00
10	lb.	@ 1.10 =	11.00
5	lb.	@ 1.20 =	6.00
22½	lb.	@ 1.00 =	$22.50

From the foregoing it will be seen that when one pound of the $0.60 wool is sold for $1.00 there is a gain of $0.40; on the $0.80 stock there is a gain of $0.20; on the 1.10 stock there is a loss of 0.10; and on the $1.20 stock a loss of $0.20. It is apparent, therefore, that it takes 2½ lb. of $0.60 wool, five lb. of $0.80 wool, 10 lb. of $1.10 wool, and five lb. of $1.20 wool mixed together to obtain an average price of $1.00, as above shown. The reason for this is that the gain on the $0.60 and $0.80 stocks exactly offsets the loss on the $1.10 and $1.20 stocks.

Suppose that in the foregoing case the $1.10 grade had been omitted and the problem had been to ascertain in what proportion stock costing $0.60, $0.80 and $1.20 should be mixed in order to obtain a mixture costing $1.00 per pound. The calculation would then be as follows:

Average Cost per Pound	Original Cost per Pound	Loss or Gain per Pound When Sold for $1.00	Pounds Required to Gain $0.50	Pounds Required to Lose $1.00
$1.00	$0.60	+ $0.40	1¼	
	0.80	+ 0.20	2½	
	1.20	— 0.20		5

1¼	lb	@ $0.60 =	$0.75
2½	lb.	@ 0.80 =	2.00
5	lb.	@ 1.20 =	6.00
8¾	lb.	@ 1.00 =	$8.75

When there are three differently priced stocks to be mixed together, the average price of the mixture will, of course, be greater than two and less than one of the materials. Therefore, if the mixture is made in such a way as to gain $0.50 on each of the two materials that cost less than the average of the mixture and to lose $1.00 on the material costing a higher price than the mixture, the correct result for proportioning the mixture to cost $1.00 a pound is obtained as shown in the foregoing calculation.

218. Waste Products in Handling Non-Ferrous Metals.—Reference to Service Bureau Bulletin No. 4 issued by the Committee on Foundry Methods of the National Founders' Association shows how the calculation of the cost per pound of good castings is made. Pounds of metals consumed and products resulting are given as follows:

Alloy No.	Amount Charged, Pounds	Good Castings, Pounds	Bad Castings, Pounds	Gates and Risers, Pounds	Melting Loss, Pounds
1	33,900	19,000	2,000	12,000	900
2	49,400	30,000	3,000	15,000	1,400
3	13,400	8,200	800	4,000	400
4	15,500	9,000	1,000	5,000	500
5	6,000	3,800	400	1,600	200
Total	118,200	70,000	7,200	37,600	3,400

From this we have, averaging all metals,

Charge:

118,200 lb. metal @ $0.28		$33,096.00

Credit:

7,200 lb. bad castings @ $0.28	$ 2,016.00	
37,600 lb. gates and risers @ $0.28	10,528.00	$12,544.00

Balance:

73,400 lb. metal consumed @ $0.28		$20,552.00

The metal to be accounted for as being consumed is equal to the 70,000 pounds of good castings plus the 3,400 pounds of melting loss, or 73,400 pounds in all, which is priced at $0.28 per pound, making a total of $20,552. In order to arrive at the cost per pound for good castings it is necessary to divide the $20,552, by 70,000 (good castings) which gives $0.2936 per pound.

It is important to notice that each alloy has its own metal cost, and that the above illustration has averaged the cost of all of these metals to show the cost of total consumption of metal for the period covered by the record.

219. Invisible Waste.— When figuring the cost of producing brass, bronze, and aluminum castings it is necessary to consider the invisible loss in melting. The following example, also taken from Service Bureau Bulletin No. 4 issued by the Committee on Foundry Methods of the National Founders' Association, illustrates the conditions found in a foundry producing castings from metals subject to loss in melting:

Metal charged		20,000 lb.
Good castings made	10,000 lb.	
Gates, risers, scrap, etc.	8,000 lb.	
Dross, pickings, etc.	1,000 lb.	
Loss by difference (invisible waste)	1,000 lb.	
Total		20,000 lb.
Loss, per cent of metal charged	5	
Loss, per cent of good castings	10	

In this example the weight of the good castings returned happens to be 50 per cent of the charged weight. The metal lost in melting, called "invisible waste," must be carried by the pounds of good castings produced.

220. Waste Products in Woolen and Worsted Mills.— When it is necessary to sort raw material to obtain good stock for manufacturing purposes it is essential that an allowance be made for any waste material that has a value. In the case of a woolen or worsted mill the low grades of wool resulting from the sorting operation have to be appraised and deducted from the original cost of the lot, in order to arrive at the cost of the good wool. This is a common practice throughout the woolen industry. The mode of calculation will be understood from the following example:

EXAMPLE: If a lot of grease wool weighing 500 pounds cost $0.25 per pound and after sorting yielded six pounds of clippings worth $0.05 per pound, 10 pounds of strings worth $0.03 per pound, 100 pounds of low sorts worth $0.10 per pound, and 384 pounds of sorted wool, what would the cost per pound of sorted wool be, not including the cost of the sorting operation?

Solution

First cost of 500 pounds at $0.25			$125.00
6 lb. clippings @	0.05	$ 0.30	
10 lb. strings @	0.03	0.30	
100 lb. low sorts @	0.10	10.00	10.60
Difference			$114.40

$114.40 ÷ 384 = $0.298 per pound.

If it is desired to ascertain the cost of sorted wool, the procedure is to add the cost of the sorting operation per pound to the cost of the wool, as follows:

Cost per pound of wool in sorted wool	$0.298
Cost of sorting per pound	0.003
Cost per pound of sorted wool	$0.301

When making a calculation of the raw-material cost of the product at any point in the process of manufacture, it is necessary to consider the cost of material before treatment, loss during processing, and value of waste, as follows:

EXAMPLE: What would be the raw-material cost per pound of a lot of wool which originally weighed 1,000 pounds and cost $0.56 per pound, the waste being valued at $0.15 per pound?

Solution

1,000 lb. wool at $0.56	$560.00
Deduct 150 lb. waste at $0.15	22.50
	$537.50

$537.50 ÷ 850 = $0.63235, cost per pound.

221. By-Products.— When a manufacturing process results in by-products which are salable, the revenue received from them is an offset to the cost of production. The method of calculating the cost of production when by-products result will be understood from the following example:

EXAMPLE: What is the cost per ton of producing coke by the by-product process when the tar sold equals $0.17 per ton of coke and the ammonium sulphate $0.46 per ton of coke, in a plant producing 10,000 tons of coke per annum, the cost of coal and coking being as follows for the year:

Coal		$22,700.00
Coking:		
Labor	$5,200.00	
Materials	2,900.00	
Repairs	1,100.00	
General Expense	1,700.00	
Depreciation	1,000.00	11,900.00
Total		$34,600.00

Solution

Coal			$22,700.00
Coking		$11,900.00	
Less by-products:			
Tar	$1,700.00		
Ammonium sulphate	4,600.00	6,300.00	
Net cost of coking			$ 5,600.00
Total cost of 10,000 tons coke			$28,300.00
Cost per ton			$2.83

222. Percentage of Gain, Loss, and Yield.— In order to make certain calculations of the cost of material, it is necessary to arrive at the percentage of gain, or loss, or yield. The method of figuring the various percentages will be understood readily from the following example:

EXAMPLE: A manufacturer of sole leather put 840 green hides, weighing 40 pounds each, into process. When they were taken out of the soaking pits they were put on the scales and were found to weigh 45,696 pounds in the "white." When finished the same lot of hides weighed 25,200 pounds. What was the per cent of gain for the hides when in the "white" ready for the tanning process, and what was the yield when the hides were finished?

Solution

(1)

Weight of green hides, 840×40	33,600 lb.
Weight of hides in the "white"	45,696 "
Gain	12,096 "

$12{,}096 \div 33{,}600 = 36$ per cent gain.

(2)

Weight of green hides	33,600 lb.
Weight of hides finished	25,200 "
Loss	8,400 "

$8{,}400 \div 33{,}600 = 25$ per cent loss.

(3)

$100 - 25 = 75$ per cent yield, or 75 pounds of finished leather per 100 pounds of raw hides.

223. Cost of Yield.— It may be of interest to note that a manufacturer of sole leather is primarily interested in the yield of finished products obtained from the raw hides used.

1. *Cost After a Loss in Weight.*— The cost of material per unit after it has undergone a loss in weight is found by dividing the original cost of 100 units by the yield per 100 units. The application of this principle will be readily understood by referring to the following examples:

EXAMPLE: If 100 pounds of wool in the grease (before cleaning) cost $0.24 per pound and lose 55 per cent in scouring, thereby making the yield 45 per cent, what will be the cost of clean wool?

Solution

$\$0.24 \div 45\ (100 - 55) = \$0.53\frac{1}{3}$ per pound.

In this connection it should be noted that the unit cost after the change multiplied by the yield per cent gives the first cost, as illustrated by the following example:

EXAMPLE: If $0.53⅓ is the cost of scoured wool per pound and the yield of wool in the grease (before cleaning) is 45 per cent, what is the cost of one pound of wool in the grease?

Solution

$\$0.53\frac{1}{3} \times 45$ per cent $= \$0.24$ per pound.

2. *Cost After a Gain in Weight.*— The cost of material per unit after it has gained in weight is calculated by dividing the original cost per unit by 100 plus the per cent of gain. The following example shows how this rule is applied:

EXAMPLE: If yarn that cost $0.77 per pound gained 10 per cent in a damp storeroom, what would be the cost after the gain?

Solution

$100 + 10 = 110$ per cent yield

$\$0.77 \div 110$ per cent $= \$0.70$ per pound.

As in the preceding case, the unit cost of material after the gain in weight multiplied by the yield per cent gives the original cost of the material.

3. *Cost After a Loss in Weight, Including the Cost of One or More Manufacturing Processes.*— In case it is desired to ascertain the unit cost of material after a loss in weight, including the cost of one or more manufacturing processes, the procedure is as follows: If the unit cost of the manufacturing process is based on the original weight, it is necessary to add the cost of the raw material to the cost of the process per unit before proceeding with the calculation. However, if the cost of the process is based on the final weight, the cost of the operation can be added at the end of the calculation. The method of procedure will be understood readily by referring to the following example involving two operations, the cost of one of which is added to the original cost of the material, while the cost of the other is added to the final weight.

EXAMPLE: If a lot of wool costs $0.15 per pound in the grease and shrinks 60 per cent in scouring and carbonizing, the scouring costing $0.30 per hundred pounds, grease weight, and the carbonizing costing $0.01 per pound, carbonized weight, what would be the total cost per pound carbonized?

Solution

Cost of grease wool per pound	$ 0.15
Cost of scouring	0.003
	$ 0.153
Cost of 100 pounds in grease @ $0.153	$15.30
Cost per pound clean ($0.153 ÷ 40)	0.3825
Cost of carbonizing	0.01
Total cost per pound carbonized	$ 0.39¼

4. *Cost After a Gain in Weight, Including the Cost of One or More Manufacturing Processes.*— In case the material gains in weight after undergoing one or more manufacturing processes, the procedure is the same as in the foregoing example, except that the percentage of gain is added to 100 as shown in the next example:

EXAMPLE: If a lot of yarn costing $0.82 per pound gained three per cent in dyeing and the cost of dyeing was $0.08 per pound of the original weight, what would be the total cost per pound of dyed yarn?

Solution

($0.82 + $0.08) ÷ 103 = $0.873 per pound.

224. Remnants.— When remnants result from the production of a fabric, it is usually desirable to state what proportion of the yardage was put into remnants, as follows:

EXAMPLE: If 6¾ yards of remnants were cut from a piece of goods 353 yards long, what proportion was put into remnants?

Solution

6.75 ÷ 353 = 1.91 per cent.

225. Take-Up in Weaving.— During the process of weaving the warp is stretched tight in the loom. When the fabric is taken from the loom after the weaving process it shrinks on account of the so-called "take-up" due to the interlacing of the filling yarn with the warp yarn. The method of calculating the percentage of shrinkage and yield is as follows:

EXAMPLE: A warp measuring 360 yards produced 336¼ yards of cloth from the loom. Find the yield and shrinkage in length, which includes take-up, etc.

Solution

360 — 336¼ = 23¾ yards shrinkage
23¾ ÷ 360 = 6.6 per cent shrinkage
100 ÷ 6.6 = 93.4 per cent yield

226. Textile Calculations.— The following table shows the lengths with the equivalent weights for the different systems of numbering yarns:

Run (woolen)
1,600 yard lengths per 7,000 grains

Cotton
840 yard lengths per 7,000 grains

Worsted
560 yard lengths per 7,000 grains

Linen
300 yard lengths per 7,000 grains

The yarn count is calculated from the length and weight by using the following formulæ:

$$\frac{\text{Length}}{\text{Weight}} = \text{Length per unit of weight}$$

$$\frac{\text{Length per unit of weight}}{\text{Length of hank}} = \text{Fixed weight count}$$

1. *Finding the Cotton Yarn Count.*— Since a No. 1 cotton thread contains one 840-yard hank to the pound, it is an easy matter to determine the number of any yarn if the yards and weight in pounds are given. The method is, first to find the number of yards to a pound, and then to divide this figure by 840, which gives the cotton yarn number, as illustrated by the following example:

EXAMPLE: What is the cotton yarn count if 45,360 yards of cotton yarn weigh 6 pounds?

Solution

45,360 ÷ 6 = 7,560 yards per pound
7,560 ÷ 840 = 9 (hanks per pound)
The cotton yarn is therefore a No. 9.

Suppose it is desired to ascertain the cotton yarn count for a warp having a certain number of ends when the length and weight are known. The method of making the calculation is: first multiply the number of ends by the length in yards and divide the result by the weight, which gives the yards per pound; then divide the yards to a hank in a unit of the number, as in the preceding example, to obtain the yard number. The following example will make the method clear:

EXAMPLE: What is the cotton yarn count for a cotton warp 480 yards long having 2,100 ends and weighing 31½ pounds?

Solution

2,100 ends × 480 yards = 1,008,000 yds. of yarn
1,008,000 ÷ 31½ = 32,000 yds. per pound
32,000 (yds. per pound) ÷ 840 (yds. per hank) = No. 38.1
The cotton yarn is therefore No. 38.1.

Sometimes only a short length of yarn is available and its weight is given in grains. Since 840 yards weigh 7,000 grains for No. 1 cotton yarn, $^{12}/_{100}$ yards is the length of one grain of No. 1 cotton yarn. This is the same as saying that one grain of No. 1 cotton yarn is 4.32 inches long. The calculation of the cotton yarn number when the length is given in yards and the weight in grains is given in the following example:

EXAMPLE: If 48 yards of cotton yarn weigh 20 grains, what is the cotton yarn number?

Solution

48 ÷ 20 = 2.4 yds. per grain
2.4 ÷ 0.12 = 20 ($^{12}/_{100}$ yard lengths per grain)
The cotton yarn is therefore No. 20.

2. *Finding the Worsted Yarn Count.*— Since there are 560 yards in a pound of No. 1 worsted yarn, the count can be found from the weight and length by dividing the length by the weight, to obtain the yardage per pound. This result divided by 560 gives the worsted yarn number, as shown in the following example:

EXAMPLE: If 20 pounds of worsted yarn measure 336,000 yards, what is the worsted yarn number?

Solution

336,000 ÷ 20 = 16,800 yds. per pound
16,800 ÷ 560 = 30
The worsted yarn is therefore No. 30.

3. *Finding the Linen Yarn Count.*— Since 300 yards of linen weighing one pound constitute a unit of the number, the calculation can be made in a manner analogous to the previous cases.

EXAMPLE: If 300 yards of linen yarn weigh 500 grains, what is the yarn number?

Solution

7,000 (grains per pound) ÷ 500 grains = 14
The linen yarn is therefore No. 14.

4. *Finding the Cotton Yarn Count Corresponding to Woolen Yarn Count.*— A problem which frequently arises in the textile industry is to find the cotton yarn number corresponding to some other yarn, as woolen. For example, if the length of woolen yarn is given in inches and the weight in grains, the cotton yarn number corresponding can be found as follows:

EXAMPLE: If 432 inches of woolen yarn weigh 10 grains, what is the cotton number corresponding?

Solution

432 ÷ 10 = 43.2 in. per grain
36 in. ÷ 8⅓ (grains per yard, cotton count) = 4.32 in. per grain
43.2 ÷ 4.32 = 10
The corresponding cotton yarn number is therefore 10.

5. *Finding the Cotton Yarn Count Corresponding to the Worsted Yarn Count.*— The cotton yarn number corresponding to a worsted yarn number can be found first, if desired, and then the worsted yarn number, as in the following example:

EXAMPLE: If 126 inches of worsted yarn weigh 2.4 grains, what is the cotton yarn count?

Solution

$$126 \text{ (in.)} \div 2.4 \text{ (grains)} = 52\tfrac{1}{2} \text{ in. per grain}$$

$$52.5 \div 4.32 = 12.15 \text{ (cotton or 4.32-in. lengths per grain)}$$

$$\text{No. } 12.15 \text{ cotton} \times \frac{840}{560} = \text{No. } 18{,}225 \text{ worsted}$$

227. Summary.— It is necessary to make a careful study of the conditions existing in each industry in order to ascertain just what calculations must be made in connection with figuring material costs. Many physical changes which take place in material during its passage from the raw-material state into the finished product affect the cost per unit of material. Each change requires that a calculation be made, in order that a new price may be put on the material. The foregoing calculations are suggestive of what is required under a number of different conditions.

QUESTIONS ON CHAPTER XVI

1. What is the best method to follow in attaching a new scale of prices to material which has been graded? Give an example.
2. What is meant by alligation? In what proportion should wool costing $0.60, $0.80 and $1.20 per pound respectively be mixed together in order to give a mixture costing $1.00 a pound?
3. How is the loss in melting accounted for in a non-ferrous metal foundry? If 7,400 pounds of metal at $0.30 per pound are consumed and the loss in melting 400 pounds, what is the cost of metal per pound in the castings produced?
4. What is the proper procedure for handling low grades of wool after the sorting operation in a woolen and worsted mill? If a lot of grease wool weighing 1,000 pounds cost $0.50 per pound and after sorting yielded 100 pounds of low sorts worth $0.20 per pound, what would the cost per pound of sorted wool be, not including the cost of the sorting operation?
5. If it is desired to ascertain the cost of sorted wool including the cost of the sorting operation, what is the procedure?
6. What is meant by percentage of gain, loss, and yield? If 1,000 pounds of cotton yarn produces 970 pounds of mercerized cotton hosiery, what is the yield per cent?
7. How is the cost after a loss in weight figured? If 500 pounds of raw hides cost $0.50 per pound and lose 20 per cent in tanning, thereby making the yield 80 per cent, what will be the cost of tanned hide stock?
8. How is the cost after a gain in weight figured? If raw silk that cost $5.00 a pound gained 20 per cent while being made into black taffeta silk, what would be the cost of silk stock after the gain?

9. How is the cost after a loss in weight, including the cost of one or more manufacturing processes, figured?
10. How is the cost after a gain in weight, including the cost of one or more manufacturing processes, figured?
11. How many yards to a hank of No. 1 cotton yarn?
12. How many hanks of cotton yarn in a pound of No. 30 cotton yarn?
13. If 20 840-yard hanks of cotton yarn weigh one pound, what is the cotton yarn number?
14. What is a good method for calculating the cost of material in 1,000 common red bricks if they are made from a mixture of three tons of clay, extracted from a clay bank at $0.75 per ton, and one ton of bats (broken bricks) at $1.65 per ton?
15. Suggest a cost unit for the food supplies used at a hospital where a separate service is maintained for patients, doctors, nurses, and help.
16. Suggest a cost unit for the forage consumed by the horses used in the delivery service of a large express company.
17. What is a good cost unit to use for the motor-vehicle supplies required monthly by a large taxicab company?

PART IV
LABOR COSTS

CHAPTER XVII

INTRODUCTION TO LABOR COSTS

228. The Element of Labor Cost.— In order to answer accurately the question as to the cost of direct labor in each unit of the product, it is necessary to introduce a system of records that will furnish the required information regarding the amounts paid operatives, on the one hand, and the distribution of these amounts between processes or jobs, on the other. The records that are kept of the employees must be devised in such a way that any information essential for either payroll or cost purposes may be obtained readily. Where operatives are employed by the hour, the problem of making any calculation pertaining to wages or labor costs resolves itself into one of finding the length of time first, and then in multiplying the time by the employee's rate. If operatives are employed at piecework rates, the total labor cost is found by counting the pieces and extending them at the proper piecework rates.

229. Time Work.— It is in factories where time work prevails that the principal difficulties are encountered in making labor-cost calculations. The reason is that considerable clerical detail is involved in keeping the necessary records of time spent on processes or individual jobs. One can understand readily that in a plant where each operative works on several jobs every day, giving two hours to this job, an hour and 40 minutes to that, three hours to another, etc., as is the case in a factory making a varied line of jewelry, the work of time-keeping, as a basis for distributing the day's wage among the various jobs assumes considerable proportions. Nevertheless, in order to ascertain the labor cost of each job or product, it is necessary to obtain a proper distribution of the time spent. There are a number of mechanical devices in use, such as electric time-stamps and clocks which register time, which are designed to obtain correct records as a basis for making up the payroll and figuring labor costs.

230. **Piecework.**— Less difficulty is encountered in making labor-cost calculations where piecework prevails than where operatives are paid by the hour. The reason is that when the piecework rate is known, the labor cost for a unit of the product is also known. All that is necessary in order to arrive at the payroll or the total labor cost is to make a count of the pieces produced, provided that complications have not arisen because the inspector has rejected some units as defective. How to overcome this difficulty will be explained later.

231. **Payrolls.**— The mode of procedure usually followed in exercising control over payroll disbursements is to require that an accurate record be kept of the time of entrance and exit of all employees who work on an hour basis and a strict count of the production of pieceworkers. The time of hourly workers for payroll purposes is usually obtained from time cards which are stamped in a time-recording clock. In the case of day workers, clock records furnish the basis for making up the payroll, though they do not give information for the distribution of the total time among jobs or processes. This is usually accomplished by means of special time cards which are stamped in a time-recording clock. Obviously, the earnings of premium workers are not dependent upon time but upon production and rates paid. Special records have to be introduced in order to check the earnings of piece- and premium workers and to compute the amount due for payroll purposes.

232. **Distribution of Time in Process Plants.**— In a process plant where the worker is paid on a time basis his total pay for a period must be divided by the total output to determine the unit labor cost of the product. In practice it is usually the total pay of a number of men for each of a number of processes that must be so distributed. Take, for example, a continuous-process plant where plain cotton goods are finished. Here numerous processes are continually being carried on; thousands of yards of cotton fabric are being passed through the bleachery, and the same is true of other processes, such as mercerizing, dyeing, printing, and so on. The plan of cost-finding in such a plant requires that the total labor cost be allocated to processes. This is done by means of distribution sheets showing how each operative spends his time. At the close of the period, the footings to these sheets show how much time belongs to each process and how much is a charge against the General

Expense account. This information enables the proper entries to be made to the cost accounts, one of which is kept for each process. It is quite usual in continuous-process plants to make a distinction between productive labor and repair labor. If this is done, the time of repair men is separately distributed to departments and processes as expense and not as a direct-labor charge.

233. **Distribution of Time in Job-Order Factories.**— In a job-order factory, if operatives are paid by the hour, it is necessary to establish the principle that no time will be paid for unless charged to a job number. The issuing of a production order is the authority for the operating departments to do work on the order and to charge time to that order. These orders are of two kinds, (1) regular production orders for individual jobs, and (2) standing expense orders issued to authorize certain kinds of work to be done when necessary, such as making minor repairs to machinery, caring for an injured employee, and so on. The time-keeping system must show the time that each operative spends on individual jobs, and also the total time on production orders, separated from the time on standing expense orders. This can be accomplished by giving each operative a daily time sheet on which he shows the time spent on each job, or by giving him individual time tickets, one of which is used for each job worked on. If time sheets are used, the time spent on a job has to be extended and posted to the cost sheets for the various jobs. If individual-job time tickets are used, they can be filed by job numbers until a job is reported finished, whereupon the tickets for the job are removed from its file and the labor cost posted to the proper job cost sheet in the Cost Ledger.

A furniture factory offers a good example of a job-order factory where the time of all operatives must be kept by job numbers. Thus, in the mill, when an operative begins work cutting out the pieces for a job, he indicates the time started on a time ticket stamped with the job number. When he finishes, he makes a similar record, so that the elapsed time can be figured readily. The time of productive workers is recapitulated after each period by job numbers, keeping the time of the employees of each department separate. The time thus accumulated against job-order numbers in each department is posted to the job cost sheets, of which there is one for each job.

If the cost system requires that data be obtained regarding the number of productive hours worked, it is necessary that the hours spent in each department on a job be shown, in addition to the money cost of the time.

234. **Time-Recording Devices.**— The records introduced for the purpose of obtaining the time operatives spend on jobs may be hand-written or stamped in a time-recording device. The use of special time clocks or stamps is, without doubt, a more efficient and accurate method than that of depending upon records written by hand. The use of time recorders is a good practice, whether the operatives themselves or a factory clerk records the time of starting and the time of finishing each job.

235. **Factory Organization.**— In order to make a proper analysis of the payroll it is the custom to departmentalize the factory. A study of the organization is one of the first steps taken when planning a cost system. One of the most convenient means for indicating the departments of a business enterprise consists of organization charts. The method followed in charting an organization for the purposes of cost accounting will be presented in the next chapter.

Questions on Chapter XVII

1. What is the relation between the payroll and the cost of labor on the product?
2. What problems are involved in making a calculation of the labor cost on a unit of the product?
3. How is the labor cost calculated where time work prevails? Where piecework prevails?
4. What basis is used for making up the payroll of time workers? Of pieceworkers?
5. How should the payroll be distributed in process plants? In job-order factories? Give examples.
6. What mechanical aids can be introduced for the purpose of obtaining a correct record of time?
7. What purpose would be served by charting the organization preparatory to installing a cost system?
8. Draw an organization chart for a typical automobile garage, sales and service station.

CHAPTER XVIII

DEPARTMENTALIZATION OF THE PAYROLL

236. **Classification of the Payroll.**— In order to present a basis of payroll analysis that will give ready information concerning the labor cost, both direct and indirect, of a unit of the product, it is necessary to make a careful study of the organization units into which a business is divided. The departments in a typical manufacturing enterprise may be assumed to be somewhat as follows:

Organization of the A. Company

- General Administration:
  - Executive:
    - President
    - Vice-President
    - Secretary
    - Treasurer
  - Accounting
  - Clerical and stenographic
- Manufacturing:
  - Superintendent of Manufacturing:
  - Department A:
    - Foreman
    - Operatives
  - Department B:
    - Foreman
    - Operatives
  - Department C:
    - Foreman
    - Operatives
- Selling:
  - Sales Manager
  - Salesmen

The division of the business into departments is seen readily from the foregoing chart and also the direct and indirect labor classifications. For such a typical plant the payroll analysis can be arranged as shown below for the purpose of separating indirect from direct labor:

PAYROLL ANALYSIS

Indirect Labor:
- General Administration Overhead:
  - Part Manufacturing
  - Part Selling
- Selling Overhead
- Manufacturing Overhead:
  - Part Department A
  - Part Department B
  - Part Department C
- Departmental Overhead:
  - Department A
  - Department B
  - Department C

Direct Labor:
- Department A
- Department B
- Department C

It is evident from the foregoing analysis that the direct labor cost for each department may be easily obtained, and the same is true of the indirect labor covering such items as the departmental foremen's wages. However, when it comes to the office of the superintendent of manufacturing we find an item of overhead which must be apportioned among Departments A, B, and C. Finally, there is general administration overhead which is applicable in part to manufacturing and in part to selling.

The farther one goes away from a production department the more difficult becomes the problem of the proper apportionment of indirect labor. Indirect labor is included in overhead expense and the problem of its allocation to the various units of the product will be dealt with in a subsequent part of this work.

237. **Departmentalization.**— Although we are concerned here primarily with the direct labor cost and not with the distribution of overhead, we must have both in mind, in order to grasp the principles of factory organization and its consequent system of departmentalization. An organization in which one finds only administration, manufacturing, and selling departments is simple in form. However, in case each of these departments is subdivided, the business is spoken of as being highly organized. In cost work it is generally necessary to treat each department of an enterprise as a separate unit.

238. **Examples of Departments.**— The duties performed by employees in any enterprise can usually be ascertained by a little investigation. Thus, in a job-printing plant one finds the general administrative office, composing room, press, and bindery departments, each of which has its own work to perform. In making a study of an organization for cost purposes one of the first matters to determine is which are the so-called productive, and which the non-productive departments. The former comprise those organization units in which the various processes of manufacture are performed directly *on the material,* such as the blanking, stamping, press work, soldering, enameling, and polishing done in a jewelry factory. The non-productive departments cover those activities which have to do with furnishing general or indirect services such as heat and power, janitor service, repair work, storeskeeping, and supervision. The terms "direct labor" and "indirect labor" are used by cost accountants to indicate whether or not wages can be applied directly to the product. The labor of a printer who is running a press on a customer's job is classified as direct, while the work of the bookkeeper in the office who makes out the invoice to the customer is indirect. Obviously it would be impracticable to try and allocate the bookkeeper's time directly against each unit of production. The analysis of an organization made for determining what departments it is divided into can be presented most conveniently in chart form.

239. **Organization Charts.**— Organization charts will be presented showing the departmentalization of the payroll in a silk-throwing mill, printing factory, jewelry establishment, toy shop, and textile plant. They illustrate how industrial enterprises are organized and they show how charts needed for cost purpose reference should be made. Both process and job-order forms of production are included in the enterprises taken for illustration. Sometimes an organization chart can be prepared directly from the payroll, and at other times it is necessary to interview every operative as to his particular duties in order to locate each employee correctly on the organization chart. Properly prepared organization charts are valuable for administrative purposes because they show the number of operatives employed at each occupation, and the prevailing rates of compensation.

240. Organization Chart for a Silk-Throwing Mill.— The first chart presented, Exhibit L, shows how a silk-throwing mill is organized. The administration, shipping, and power-service departments are listed as general overhead activities. Under the manufacturing section are grouped the various processes necessary to convert raw silk into thrown silk ready for use in weaving.

The process of manufacturing thrown silk is continuous, and is as follows. The original bales of raw silk are opened and the gummy substance which adheres is soaked off (see Opening and Soaking Departments on chart). The raw silk is then wound on bobbins which

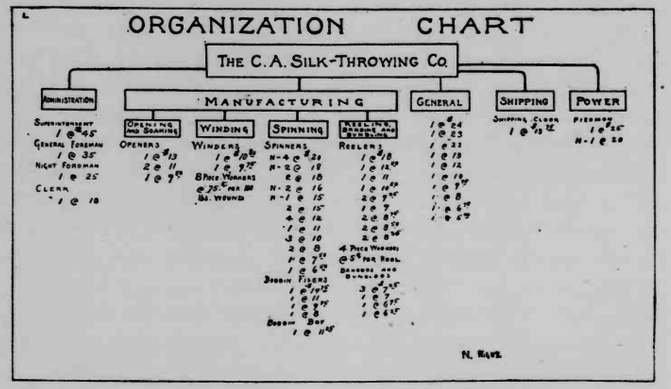


EXHIBIT L. ORGANIZATION CHART FOR A SILK-THROWING MILL

resemble spools, so that it can be handled by the spinner (Winding Department on chart). In order to give the raw silk the strength requisite for weaving into various styles of goods on the looms it is necessary to spin, throw, or twist two or more ends of raw silk together (Spinning Department on chart). This operation is accomplished on the spinning frames. Any desired number of ends can be twisted together by drawing off the silk from the proper number of bobbins onto one spinning-frame bobbin. If the product of a silk-throwing mill is shipped in skeins, it is necessary to wind the silk into skeins on a reel, after which the skeins are tied with bands and put into bundles (Reeling, Banding, and Bundling Departments on chart).

The number of employees at their respective rates of compensation in the various departments of the organization is also given in Exhibit L. Such a chart enables the accountant to arrange the names of the laborers on the payroll by departments, and it is a simple matter to get total departmental costs for direct labor from such a classified payroll.

241. Organization Chart for Job-Order Printery.— A large printing establishment furnishes a good illustration of the method

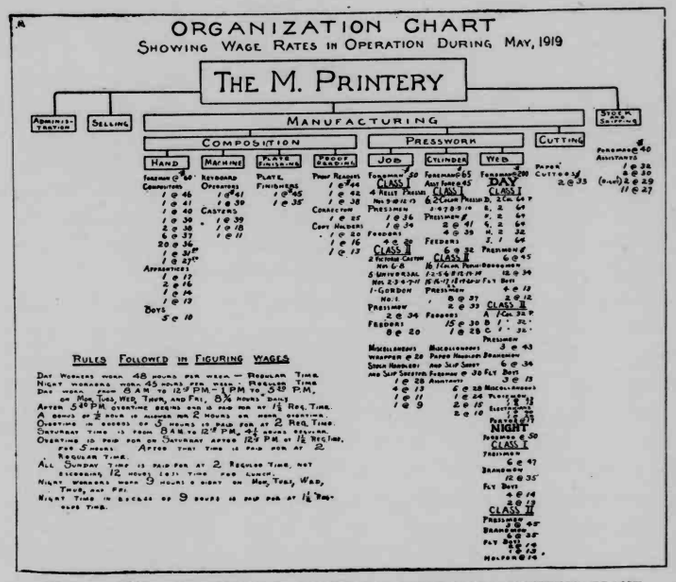


EXHIBIT M. ORGANIZATION CHART FOR A JOB-ORDER PRINTING PLANT

followed in charting the organization for a job-order factory. Reference to Exhibit M shows that the organization is divided into the administration, selling, manufacturing, and shipping departments. But the cost accountant is interested mostly in the manufacturing division which is shown subdivided into composition, presswork, and cutting departments. An analysis of the composing room shows that the operations there consist of hand composition, machine com-

position (monotype work), plate finishing, and proof reading. If linotype machines were in use as an additional means of composition, there would be another square. Under press work one finds job, cylinder, and web presses.

In the press department of a job-printing establishment it is very important to list the number of presses of each size on the organization chart; the reason being that the wage rates of pressmen and feeders depend upon the size of press tended. Thus, for example, a pressman on a two-color web press is paid $45 a week while a pressman on a one-color web press receives $43, which is two dollars a week less. It also makes a difference whether the pressmen work at night or in the daytime. The pressman on a two-color web press receives $47 a week for night work while the pressman on a one-color web press receives $45. The organization chart furnishes as much information about the number of employees and their rates of compensation as possible. Obviously this printing establishment sends its products out to be bound, but if it operated a bindery then the organization chart would have to show a bindery department coordinate with composition, press work, and cutting.

A special feature of the organization chart (Exhibit M) is the table of rules followed in figuring wages. It will be seen that a rather complicated system prevails for figuring the amounts earned by printers. For example, overtime (time and one-half) for day workers begins at 5:30 P. M. on Monday, Tuesday, Wednesday, Thursday, and Friday. After five hours of overtime operatives are paid double time. On Saturday overtime begins at 12:15 P. M. and after 5:15 P. M. double time begins. On Sunday all time is double time. Day workers work 48 hours and night workers 45 hours per week. After nine hours of work night workers are paid at overtime rates. The complete rules for calculating amounts earned are given on the chart shown in Exhibit M. A cost accountant cannot do better than to chart just such an organization scheme, with all essential information concerning the nature and time of work, in any establishment in which he is introducing or operating a cost system.

242. Organization Chart for a Jewelry Manufacturing Establishment.— The departmentalization of a jewelry factory making a sterling silver and metal line, much of which is set with stones,

is illustrated in Exhibit N. Reference to the organization chart shows that the function of merchandising is developed to a considerable extent. Under "Store" one finds the various activities of selling, showroom, finished stock, and shipping. The factory operations consist of making castings in the foundry from patterns made by the model maker, and these are used for making the sterling silver

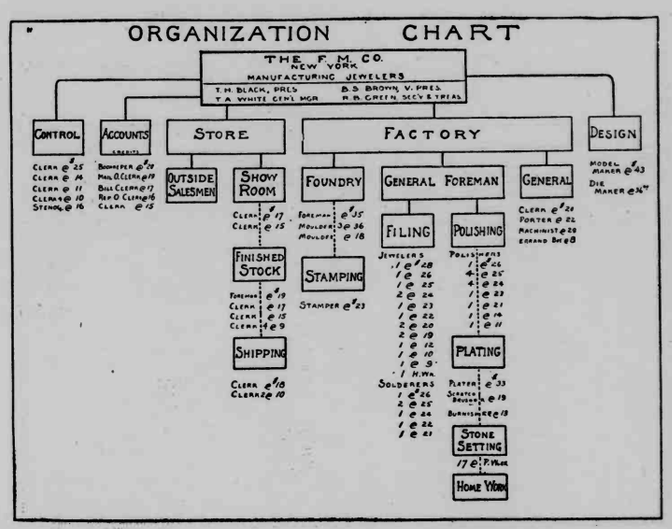


EXHIBIT N. ORGANIZATION CHART FOR A JEWELRY MANUFACTURING ESTABLISHMENT

line of buckles, brooches, and so on. Pieces for making brass goods are stamped up by means of dies made by the die maker and then the castings and brass pieces which have been struck up by the dies are manufactured into the finished product by jewelers, solderers, polishers, platers, and stone setters. When the factory product is completed, it is delivered to the store.

The chart shows the number of employees at work in the various departments, together with their respective rates of compensation. It will be seen that both weekwork and piecework prevail. Some

operatives work at home and they are, of course, paid at piecework rates.

243. Organization Chart for a Machine Shop and Assembling Plant.— Plants in the mechanical industries are usually divided into departments which make parts from raw material and subsequently assemble them into the completed product. The organization of an electrical-toy factory is shown in Exhibit P. Under each department are listed the number of employees in each occu-

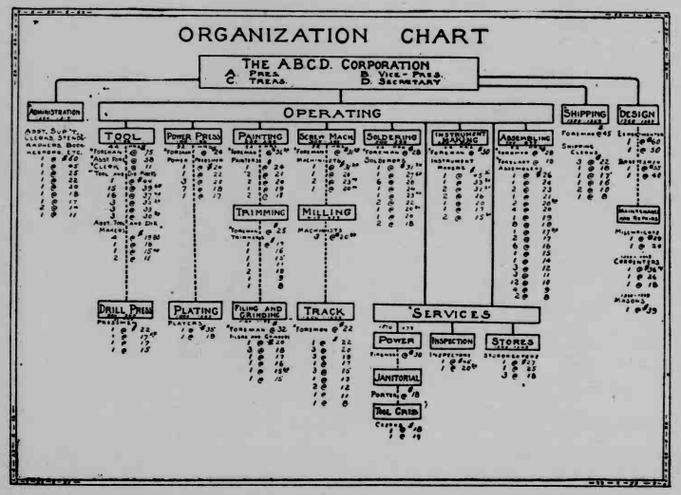


EXHIBIT P. ORGANIZATION CHART FOR A MACHINE SHOP AND ASSEMBLING PLANT

pation and their respective rates of compensation. Tool makers work 44 hours a week and the other operatives in the factory 52 hours a week. An "X" is used to indicate the so-called non-productive employees whose wages are chargeable to overhead expense. All the employees under administration, shipping, design, services, maintenance, and repairs are classified as non-productive or indirect labor, and are chargeable to the general Factory Expense account. The foremen, assistant foremen, and clerks in the operating departments are chargeable to the Overhead Expense account of the departments where they are employed. The time of the remainder of the

factory employees is charged direct to jobs as a part of the prime cost. The plant is situated outside of New York, while the main office is in the city. For this reason the Organization Chart in Exhibit P does not show any selling department, because this is located at the main office. The chart shows all the factory employees classified as to direct and indirect labor. With such a chart as the one shown a calculation can be made readily, showing the amount of the weekly payroll, and the ratio of direct and indirect labor.

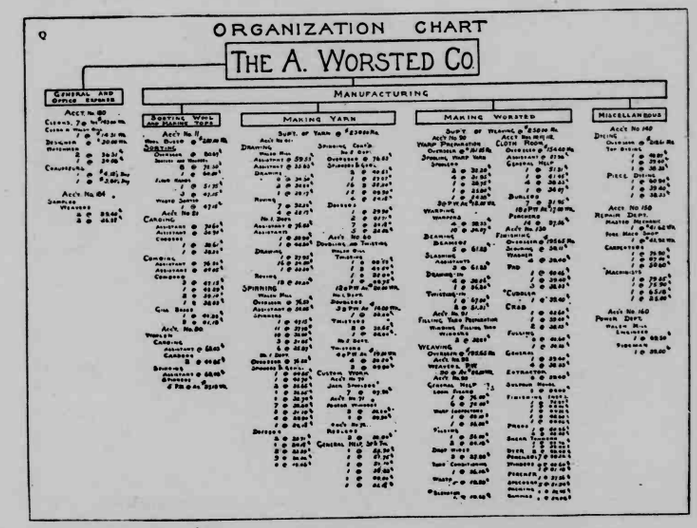


EXHIBIT Q. ORGANIZATION CHART FOR A WORSTED MILL

244. Organization Chart for a Worsted Mill.— In a large textile mill, such as one performing all of the processes necessary to convert wool into worsted suitings, there are many departments and operations. In a worsted mill of this type, the organization of which is shown in Exhibit Q, there are four main divisions in the manufacturing processes: (*1*) sorting wool and making tops (a top is a ball of loose strands of wool weighing about ten pounds), (*2*) making yarns, (*3*) making worsted, and (*4*) miscellaneous operations such as dyeing tops or piece goods. Up to the time that the

making of worsteds commences, the operations are continuous processes. When the superintendent of weaving commences operations, it is always on a particular style of fabric which has to be woven in exactly the manner called for by the design. The superintendent of weaving issues production orders for each fabric which he desires to have produced. The miscellaneous items of dyeing, repair work, and power service are closed out to the wool, yarn, and worsted accounts on the basis of the service rendered each.

Unless otherwise indicated wages are paid by the hour. Reference to the chart shows the number of persons employed at the various occupations, together with their respective rates of compensation.

245. Summary.— The preparation of organization charts such as those presented in this chapter furnishes a good means for showing how the payroll should be departmentalized for cost purposes. In making these charts it is sometimes necessary to ask the employees themselves or their overseers what their duties are, for the reason that the payroll does not always make a distinction between occupations. The cost accountant needs to be accurately informed regarding what each employee does in order that an intelligent analysis of the payroll may be prepared. The proper analysis of the payroll is an important part of the routine in connection with the operation of a cost system.

Questions on Chapter XVIII

1. What purpose is served by a departmentalization of the payroll?
2. Illustrate what is meant by departments in a factory organization.
3. What is meant by productive departments? Give three examples.
4. What is meant by non-productive departments? Give three examples.
5. What use is made of organization charts in connection with cost work?
6. Draw up an organization chart for some business enterprise with which you are familiar.
7. What purpose is served by tabulating the number of operatives in each department at their respective rates of compensation when preparing an organization chart?

CHAPTER XIX

SYSTEMS OF WAGE PAYMENT

246. Labor Cost Calculations.— The organization charts in the preceding chapter show that various methods prevail for paying wages. In several of the charts it is indicated that operatives are paid at piecework rates. There are, of course, many methods for compensating workmen. However, in the final analysis the amount earned usually depends upon either the time spent or the number of pieces turned out. A premium may be paid the operative for decreasing the time spent on a job or for increasing the quantity of production in a given time. Although the various wage systems are identified by different names, it is safe to say that there are only a few basic principles underlying all of them. An understanding of these principles will enable any one to analyze the method of wage payment in operation in a particular plant, though some slight variations may be found. There are advantages in the use of each of the basic wage systems and it is desirable that the cost accountant be well informed, not only as to how the labor cost is calculated, but also under what conditions the various methods can be advantageously used. There are many points of difference between the different systems of wage payment in vogue and, therefore, each plan will be explained somewhat in detail.

The most important methods of determining the wages to be paid to a workman are as follows:

Hour-rate system
Piecework system
Taylor differential wage-rate system
Halsey premium wage system
Rowan premium wage system
Gantt task and bonus system
Emerson efficiency bonus system

The superiority of one wage system over another depends, of course, upon the local conditions existing in a plant. Often human

nature must be considered in addition to cold business factors. Where great masses of foreign and ignorant laborers are employed, it is frequently inadvisable to introduce a very complicated wage system, even though clear reasoning would show it to be to the men's advantage as well as to that of the proprietor. It is only after a careful study of prevailing conditions, and consideration of strictly scientific matters, such as the amount of the saving in the Overhead Expense account by a reduction in the time of operation, that a decision can be reached as to which plan will give the best results. It is, obviously, desirable that the wage system put into operation insure to every employee a minimum wage, and that it offer an adequate reward for extraordinary efficiency.

247. Hour-Rate System.— The hour-rate, or daywork, system of paying wages is the one in most common use because it is the simplest. The plan can be used anywhere for either high-class labor, such as mechanics, or for general utility help. It consists in paying a workman a certain rate per hour or per day, as the case may be, the rate depending upon the prevailing rate for labor of that class, and the special skill of the workman. There are, of course, certain classes of labor in all plants which have to be employed by the hour or day, as for example, engineers, firemen, inspectors, watchmen, and cleaners. Where productive workers are paid by the hour, it is necessary to depend upon close supervision by foremen, for good results from this system. That the foreman has to be relied upon to get a full day's work out of his men is the principal objection to the hour-rate plan.

If the product is measurable in units so that the time spent by each operative on a certain quantity of work can be recorded, a means is furnished for keeping a check on the workmen. If the operatives know that all increases in rates of pay will be based on their time and output records, it is likely that they will endeavor to increase their rate of production. Time tickets showing the exact time spent on each job have a good moral effect on the employees and the results obtained from labor cost reports form a valuable administrative guide in operating the factory.

248. Overtime.— Where the hour-rate wage system is in operation, it is quite a common practice to pay employees at a fixed hourly rate for regular time, and at special rates for overtime. Thus, it is often the plan to employ operatives at a weekly rate on the basis of 48 hours per week. Then time in excess of eight hours is compensated for at time and a half. After five hours overtime it is sometimes the practice to pay operatives at double the regular time rates. Working overtime tends to reduce the overhead, due to spreading the factory expense over more productive hours, and this reduction in the overhead on a job tends to offset the increased labor costs due to paying for overtime at increased rates. Usually time worked on Sundays and holidays is paid for at overtime rates.

Many who realized the defects in the hour-rate wage system have endeavored to remedy them by introducing the piecework system of wage payment which will be considered next.

249. Piecework System.— In the piecework system of wage payment the operative is paid a flat rate for each piece which he does. On the one hand, an employee who works at piecework can increase his earnings by exerting his efforts, while on the other, the operative who idles away his time is penalized. Under the piecework system the supervision of employees is less difficult than under the hour-rate method, but additional inspection of the work turned out is required, in order to maintain a high standard of workmanship and to prevent paying for defective work. It has been frequently the experience of manufacturers that after the piecework system was installed, many of the operatives increased their weekly wages by 50 or even 100 per cent. It is, therefore, evident that there are great possibilities for an increase in production when employees are given a sufficient incentive.

In order that piecework rates may be fixed in such a way that operatives will be enabled to earn a quarter or a third more than under the hour-rate plan, but under no circumstance double their earnings, it is of the utmost importance that the piecework rates be fixed very carefully. Time studies should be made for a considerable period before fixing upon the rates. Then it should be made a rule that once rates have been established they should not be reduced unless a change in the design or operations has been made.

In calculating piecework rates it is the usual practice to allow 10 per cent of the full time, or six minutes per hour for rest, leaving 54 minutes for productive work. The following calculation will illustrate the method employed in fixing piecework rates:

BASIS FOR RATE

Operatives' hourly rate, $0.30. Under the stimulus of the piecework system it is expected that the operative will be able to increase his rate one-third, making it possible for him to earn $0.40 an hour.

Allowance for lost time is 10 per cent, making the productive time 54 minutes per hour.

Time studies show that a good operative can do one piece in three minutes.

Calculation of Rate

From the foregoing data the rate is calculated as follows:

54 minutes ÷ 3 minutes = 18 pieces per hour.
$0.40 per hour ÷ 18 pieces = $0.022, or piecework rate.

The most important point to keep in mind is that it is necessary to make very careful time studies before setting the rate. Otherwise it is likely that the production of the operatives will be in excess of that contemplated when the rate was fixed.

Wherever the piecework system of wage payment is introduced it is necessary to provide an adequate method of keeping a check on the production of each pieceworker, so that every operative will be paid for all of the work he turns out, but no more. It is a good plan to compare in some way the average hourly earnings of piece workers with the earnings of day workers. It is expected that the former will average higher than the latter because of the stimulus offered by the piecework rates. In factories where both piecework and daywork systems of wage payment are in vogue it should be the practice to have all employees in each section paid either by piecework or by daywork in order to prevent a daywork operative, who is guaranteed his wages, irrespective of the pieces produced, from secretly giving a number of the pieces to a pieceworker who can turn them in to support claims for additional compensation.

The piecework system of wage payment is sometimes referred to as a 100 per cent premium system, because the operative receives all the benefit from lowering the time of production, in contrast to those wage systems in which he receives a premium equal to but a half or a third of the value of the time saved. It is because of the fact that the operatives' earnings tend to increase enormously as time is lowered that the piecework system does not ordinarily result in a reduction of the total cost of manufacture, unless the factory burden is considerably over 150 per cent. In order to overcome some of the

objectionable features in piecework and other systems of wage payment Dr. Frederick W. Taylor invented a system for paying operatives at different rates depending upon the time spent in production. This plan will be considered next.

250. Taylor Differential Wage Rate System.— Dr. Frederick W. Taylor, who was called the "father of scientific management," invented the differential wage rate system for computing the earnings of employees in a factory. The plan is devised in such a way that the operative who turns out a high output is paid at a high rate per hour, while the inefficient worker is penalized by a lower wage rate. The method consists in fixing a sliding scale of rates corresponding to the number of pieces made per hour. In this way an operative who turns out 10 pieces an hour may be paid for the work at the rate of $0.04 each, while if he produces 15 pieces an hour the rate per piece is $0.045. It will be seen by referring to Exhibit R that an operative who ordinarily does 10 pieces in 100 minutes, thereby earning $0.216 per hour, may increase his rate to $0.2[illegible]6, $0.285, $0.334, $0.40, and so on, if he decreases the time spent on the same job. The significant feature of the differential wage rate system is seen in the increasing rapidity with which the curve, showing the rate earned per hour, swings to the right as the time on jobs is lowered. A reduction in time on the job of 10 minutes, from 100 to 90 minutes, is rewarded by an increase of $0.03 in the hourly rate of pay. However, a reduction of 10 minutes, from 60 to 50 minutes, is rewarded by an increase of $0.104 in the hourly rate of pay. Because of these increased rates of pay corresponding to increased rates of production, the Taylor system is frequently spoken of as a highly stimulative wage system.

Reference to Exhibit R shows what the labor cost is on the job, corresponding to the actual time taken. When done in 100 minutes the labor cost $0.36 as shown, increasing with each 10 minute reduction in time to $0.37, $0.38, $0.39, and so on. The reason why the employer can afford to pay these amounts is that the overhead is lessened as the time taken on the job is decreased. Suppose, for example, that the overhead amounts to 30 cents an hour, or half a cent a minute. A saving of 10 minutes on the job then results in a reduction of five cents in the overhead charge. It is, therefore, seen that when the time taken on the job is reduced from 100 to 90 min-

utes the manufacturer saves five cents on overhead, and reference to Exhibit R shows that the labor cost increases one cent, the net result being a decrease in cost to the owner of four cents on the job. From the foregoing it is seen readily that a highly stimulative system of

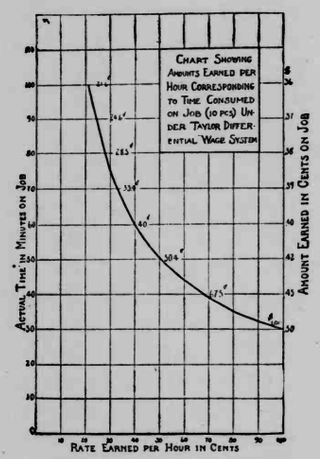


EXHIBIT R. CHART SHOWING AMOUNTS EARNED PER HOUR CORRESPONDING TO TIME CONSUMED ON JOB (10 PIECES) UNDER TAYLOR DIFFERENTIAL WAGE SYSTEM

wage payment, such as the Taylor system, is best suited to meet the needs of a plant where the overhead is high, because the amount spent in saving time is supposed to be offset by the reduction in overhead.

251. **Halsey Premium Wage System.**— In the Halsey premium wage system the plan is to reward the employee for reducing the time spent on a job by paying him a premium varying from one-quarter to one-half of the value of the time saved. It will thus be seen that this plan differs from the piecework, or differential wage systems, in that time and not the number of pieces is the basis for making the calculation of the amount earned. In order to establish the system it is necessary to fix a standard time for doing the job, and this is usually done after making time studies and determining upon the least time in which the job can be done. The operative

should be guaranteed a minimum wage, in case of accidents to the machinery. Under the Halsey 50 per cent premium wage system the operative is paid his regular hourly rate while on the job, and a premium equal to half the value of the time saved. A simple illustration will make the operation of the system clear.

Suppose an employee is paid $0.30 an hour, or a half cent a minute, and does a job in 80 minutes for which the standard time is 100 minutes. For his time he then receives his regular rate which amounts to $0.40, to which is added the premium (50 per cent of 20 minutes at one-half cent per minute), which is $0.05, making

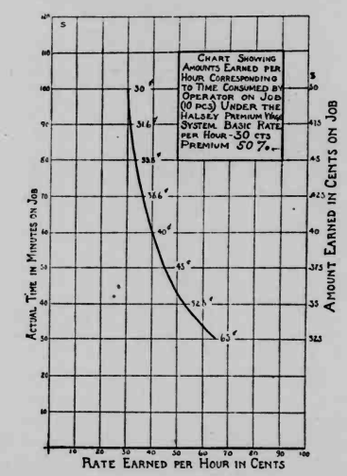


EXHIBIT S. CHART SHOWING AMOUNTS EARNED PER HOUR CORRESPONDING TO TIME CONSUMED BY OPERATOR ON JOB (10 PIECES) UNDER THE HALSEY PREMIUM WAGE SYSTEM. BASIC RATE PER HOUR — $.30, PREMIUM 50%

the total earned on the job $0.45. This is equivalent to $0.338 per hour.

Reference to Exhibit S shows how the employees' hourly rate increases from the base $0.30 to $0.316, $0.338, $0.366, $0.40, and so on as the time on the job is reduced. It will be noticed that the same possibilities do not exist under the Halsey 50 per cent premium wage system for the employee to increase his hourly rate, as under

the piece, or differential, wage system previously described. If premiums of 25 or 33⅓ per cent had been used instead of 50 per cent for calculating the earnings shown in Exhibit S, the increases would have been less. In deciding whether to use a 25, 33⅓, or a 50 per cent premium when introducing the Halsey system, consideration must be given to the ratio of factory overhead expense to labor. When the overhead rate is high there is, of course, a greater possibility of paying the operator a liberal premium for the time saved.

Besides getting regular wage receives certain percent of time that is saved

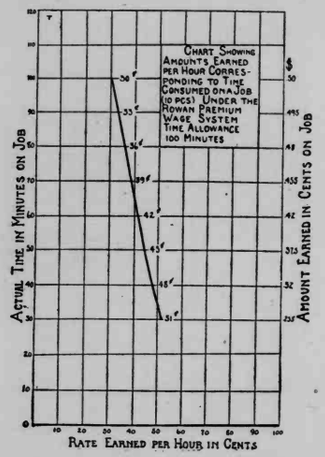


Exhibit T. Chart showing amounts earned per hour corresponding to time consumed on a job (10 pieces) under the Rowan premium wage system. Time allowance 100 minutes

252. Rowan Premium Wage System.— Under the Rowan premium wage system, the premium is proportionate to the reduction in the time. Thus, for example, if the standard time on a job is 100 minutes and an operator whose wage rate is $0.30 an hour does the job in 90 minutes he saves 10 minutes, or 10 per cent of the standard time allowance, and the amount earned on the job would be $0.45 (90 minutes at $0.30 per hour) plus a premium of 10 per cent, making a total of $0.495. This corresponds to $0.33 an hour. As the time taken on the job is reduced, the hourly earnings increase. Reference to Exhibit T shows how the rate per hour can increase

from the base rate of $0.30, when the job is done in the standard time, to $0.33, $0.36, $0.39, $0.42, and so on. It will be noticed that the curve swings to the right less than in the two preceding charts. This shows that the increases in the rates per hour, corresponding to reduced operating time on the job, are less than under the Taylor or Halsey wage systems. The Rowan system is an especially good one to introduce in plants where the standard-time de-

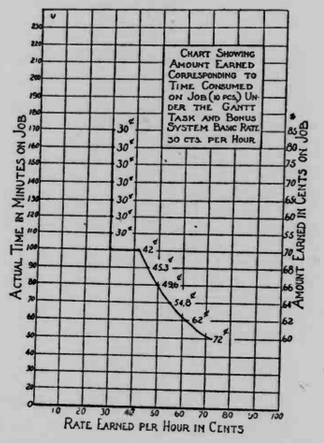


Exhibit U. Chart showing amount earned corresponding to time consumed on job (10 pieces) under the Gantt task and bonus system. Basic rate $.30 per hour

terminations cannot be made with the greatest degree of accuracy. The reason for this is that no possible error in fixing time allowances can lead to an operative earning double wages.

253. Gantt Task and Bonus System.— The plan of the Gantt task and bonus system is to set a high standard of attainment and to pay a reward only when the operative attains such a standard, after which point the bonus increases as long as the operative continues to reduce the time fixed for the task. In the various systems of wage payment previously explained the passage from the basic rate to increased rates was gradual but in the Gantt task and bonus system a flat 40 per cent bonus is added to the hourly rate upon reaching the

standard. From this point on a bonus is paid at increasing rates as shown in Exhibit U. Because of the form taken by the curve showing amounts earned per hour, this system is frequently spoken of as a "truncated premium wage system."

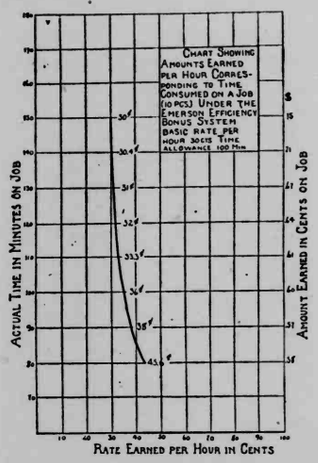


Exhibit V. Chart showing amounts earned per hour corresponding to time consumed on a job (10 pieces) under the Emerson efficiency bonus system. Basic rate per hour, $.30. Time allowance 100 minutes

In order to introduce this system it is necessary to fix the standard rates very carefully. The system of task with a bonus works best in plants where the overhead expense ratio to labor is high, because the premium paid is very liberal, starting with 40 per cent and increasing rapidly. It is thus seen that under this plan, inefficient workmen are penalized by being kept at the regular hourly rates, while efficient operatives can increase their hourly earnings rapidly. Because quick rewards for extra efforts at reducing the time on the job are given, the system also is spoken of as being highly stimulative. The plan has the added advantage of guaranteeing the operative his hourly rate as a minimum as Exhibit U shows.

254. Emerson Efficiency Bonus System.— In order to put into operation the Emerson efficiency bonus system it is first necessary

to make a very careful determination of the standard time which a job should take. At 66⅔ per cent of the standard efficiency fixed for the job the operative begins to receive a bonus for reducing the time on the job. Thus, if the standard time is 100 minutes, the bonus begins when an operative does a job in 150 minutes, or at 66⅔ per cent of the standard speed. The bonus percentage gradually increases from zero at 66⅔ per cent efficiency until at 100 per cent efficiency a 20 per cent bonus is paid. The following example will illustrate the method of calculation.

Suppose the standard time for a job is 100 minutes and that an operative does it in 120 minutes, making the efficiency per cent 83 on the job (100 ÷ 120), which is found by referring to a table to correspond to a bonus per cent of six. If the employee's hourly rate is $0.30 his wages on the job would then be $0.60 for 120 minutes plus a six per cent bonus, making $0.64 in round numbers. This corresponds to a rate of $0.32 per hour. Other rates are shown on Exhibit V. The person who installs the system must make up a table showing the bonus percentage corresponding to each efficiency percentage beginning with naught per cent at 66⅔ per cent efficiency, and arriving at 20 per cent at 100 per cent efficiency with higher bonus percentages corresponding to still higher rates of efficiency. Ordinarily the standard of attainment is fixed so high that it is almost impossible for an operative to be more than 100 per cent efficient.

In addition to the wage systems referred to in the foregoing sections of this chapter there are others, known as profit sharing, stock distribution, and so on. But these do not bear directly on the calculation of the labor cost on a job and so will not be dealt with in this discussion.

255. Summary.— Every cost accountant should have a thorough understanding of the various systems of wage payment in use so that he will experience no difficulty in making the calculation of labor costs under the conditions found to exist in any plant. In case a cost accountant is asked to recommend the introduction of a modern wage system he should bear in mind that the best system to adopt is, of course, the one which enables the operatives to earn the highest rate per hour on the one hand, while the cost of production is lowered, due to a decrease in the overhead expense on jobs, on the other. The forms and time-recording devices used for calculating the

amounts earned by operatives will be presented in the two chapters following.

Questions on Chapter XIX

1. Name seven different wage systems.
2. What is the hour-rate system of paying wages? What are its advantages and disadvantages?
3. What is the piecework system? What are its advantages and disadvantages?
4. What is the differential wage rate system? How does it differ from the ordinary straight paid work system? Under what conditions does the differential wage system give the best results?
5. What is the Halsey premium wage system? In what respect does it differ from the differential wage system? Give an example showing how the system operates. Under what conditions does the system give the best results?
6. What is the Rowan premium wage system? How does it differ from the Halsey system? Give an example of how the system operates. Under what conditions does the Rowan system give the best results?
7. What is meant by the Gantt task and bonus system? How does it differ from the Rowan premium system? Under what conditions does the Gantt system give the best results?
8. What is the Emerson efficiency bonus system? What are its advantages and disadvantages?
9. Why is it that a manufacturer can afford to pay a bonus to operatives for reducing the time spent on jobs?
10. Suggest a good wage system to be put into operation by a large manufacturer of wooden boxes. The unit of production is the number of thousand feet of lumber that pass through the (*a*) mill, (*b*) cutting (sawing), and (*c*) nailing departments.
11. Suggest a good wage system to be used as a means of increasing the efficiency of the drivers and helpers employed in the delivery service of a large department store.
12. What would you suggest as a good wage system to be used as a means for controlling the cost of operating and cleaning school buildings? The work consists of (*a*) supervision on the part of the janitor, (*b*) operation of heating and power plant, and (*c*) cleaning of building.

CHAPTER XX

PAYROLLS

256. Calculation of Employees' Earnings.— It is necessary to adopt some system of timekeeping, or of aggregate piece production computation in every shop, whether large or small, as a basis for calculating the amounts due employees for their labor. The system may be very simple in factories where employees are hired by the week or by the hour; but under the conditions found in factories where piece and premium wage systems are in operation, the method of handling payrolls is usually somewhat complicated. Simplicity in payroll procedure is not desirable, if it is secured at the sacrifice of adequate safeguards on disbursements. The timekeeping system installed should provide also a means for furnishing control over labor costs through a comparison of employees' earnings and production costs. In addition to the foregoing requirements, a good system of timekeeping should facilitate the auditing of all payroll disbursements by preventing the occurrence of payroll frauds.

257. Functions of a Time-Keeping System.— As indicated above it is the main function of a payroll system to provide a means for keeping a record of the time worked by employees, as a basis for calculating the amount due each for his labor. It is of fundamental importance that proper safeguards be placed around the system of timekeeping so as to insure that every employee will receive pay for all the work that he has done, but no more. The system of records must be so devised that no collusion between timekeepers, foremen, and employees would enable a dishonest person to pad the payroll. For example, the procedure must provide a check against carrying persons on the payroll who were not actually at work, of payments to piece workers for work done by week workers, the payment to piece workers for more work than was done, or the payment of either week workers or piece workers at rates higher than those which have been established. It is the function of the payroll system to guard

the interests of the proprietor, so that no leaks can occur in making payroll disbursements, either as the result of dishonesty or of simple carelessness.

To the end that control over the labor cost on the product may be accomplished, it is necessary to keep a record of the work which each employee is engaged upon. A record of the production of week workers is just as important as a record of the production of piece workers. When properly kept, the time records furnish a means for segregating the amounts earned according to cost-account classifications, and also furnish a basis for preparing employees' efficiency records and factory operating reports. The information obtained regarding labor costs should indicate whether or not increased earnings are accompanied by decreased unit costs, because the introduction of modern wage systems is expected to be followed by lower costs.

It should be possible to audit payroll disbursements in such a way as to satisfy the accountant that employees earned the full amounts paid them. Then if any irregularity is found, responsibility can be definitely fixed. The same necessity exists for auditing the payroll in detail that exists for making a careful examination of the cash book and bank checks.

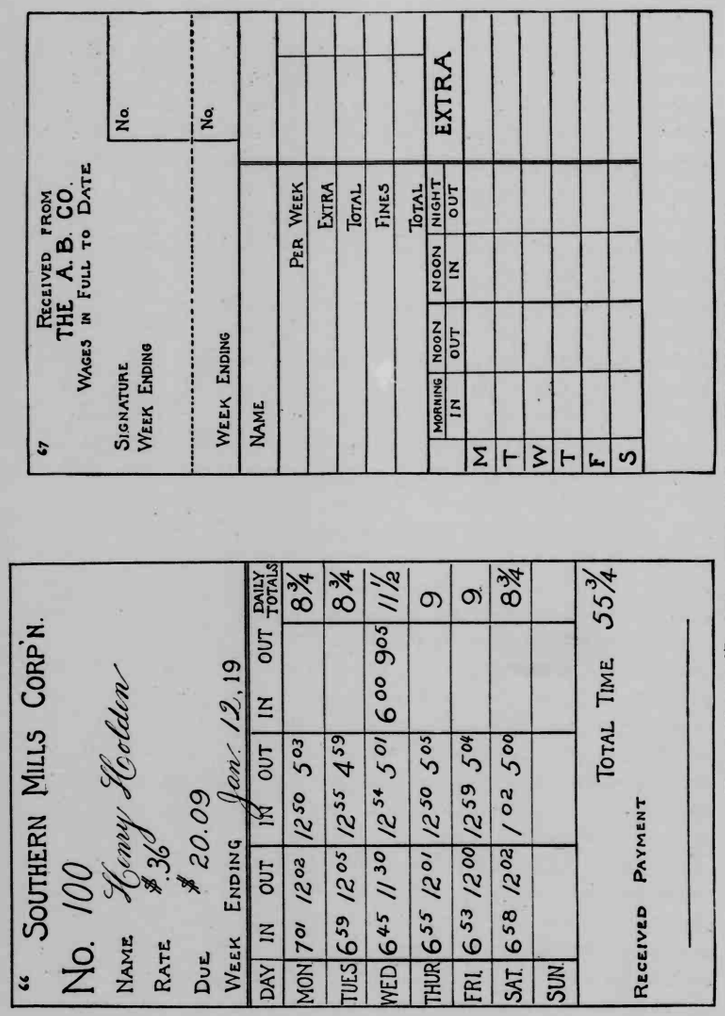
258. Employee's Information Blank.— In order to put a complete payroll system into operation with the necessary safeguards, it is a good plan to devise forms for use in keeping a complete record of the employees from the time they apply for a job until they leave the employ of the company. To begin with, it is desirable to have an "employee's information blank" to be filled in by applicants for a position. By using such a blank much time is saved the employer in interviewing applicants.

259. Employee's Application and Record Form.— There are many variations in the forms used for the employee's application blanks, some of which are designed for keeping the record of the applicant after he is engaged. When an applicant for a position is engaged, the card is turned over and the employee's name, address, position, salary, and other information are filled in as indicated. If an employee leaves of his own accord or is discharged, the facts are noted on the form to make the record complete. Employee's record cards are filed alphabetically.

260. Employee's History Card.— It is frequently convenient to use a special card for keeping the employee's history, entering thereon all details of employment, rate of pay, dates of increases, relatives employed, and employee's signature. A method is provided for grading the impression which the employee has made on past employers. The work, health, conduct, disposition, and character of the employee are graded by using the number 1 for very good, 2 for fair, and 3 for poor. When this history card is properly filled in, it shows at a glance what record an employee has made in the past.

261. Time-Keeping Systems in General Use.— Before installing a timekeeping system one of the first questions that needs to be decided is whether any mechanical aids, such as time clocks, are to be introduced for the purpose of obtaining an accurate record of the time of arrival and departure of each employee. A record made by means of a clock which indicates the exact time, when under proper supervision, is, of course, far superior to any handwritten record, whether made by time clerks or foremen. The clock record of the time of arrival and departure of employees is used as the basis for making up the payrolls of all persons paid on an hourly or weekly basis. The record of the time of all employees is also necessary as a means for checking up the time reported spent on individual jobs or processes for cost-keeping purposes. In the case of salaried employees clock records are a valuable means of determination of the punctuality and attendance of each person. There are several types of clocks on the market for recording the time "In" and time "Out" for each employee. Consideration will be given to two of the types most commonly used as a means of obtaining information required for making up payrolls as well as for administrative and accounting purposes.

262. Card Time Recorder.— One of the most common types of clocks for mechanically registering time is called the Card Time Recorder. The registering "In" and "Out" is done by means of cards, one of which must be used for each employee. Special racks are arranged for holding the cards. The "Out" rack is placed on the side of the clock nearest the entrance and the "In" rack is placed on the other. When the shop is empty the cards are all in the "Out" rack, in the various compartments provided for them.



" SOUTHERN MILLS CORP'N.

No. 100

NAME Henry Holden

RATE $.36

DUE $20.09

WEEK ENDING Jan. 12, 19

DAY	IN	OUT	IN	OUT	IN	OUT	DAILY TOTALS
MON	7 01	12 02	12 50	5 03			8¾
TUES	6 59	12 05	12 55	4 59			8¾
WED	6 45	11 30	12 54	5 01	6 00	9 05	11½
THUR	6 55	12 01	12 50	5 05			9
FRI.	6 53	12 00	12 59	5 04			9
SAT.	6 58	12 02	1 02	5 00			8¾
SUN.							

TOTAL TIME 55¾

RECEIVED PAYMENT _____

67

RECEIVED FROM THE A. B. CO. WAGES IN FULL TO DATE

SIGNATURE _____ No.

WEEK ENDING _____

WEEK ENDING _____ No.

NAME	MORNING IN	NOON OUT	NOON IN	NIGHT OUT	EXTRA
PER WEEK					
EXTRA					
TOTAL					
FINES					
TOTAL					
M					
T					
W					
T					
F					
S					

FORMS 66 AND 67. TIME CLOCK CARDS FOR USE WITH TIME RECORDER

Each card is numbered and is placed in a compartment with a corresponding number. As an employee comes in he removes his card from the "Out" rack, places it in the clock, rings the time by pressing a lever, and then places the card in its proper compartment in the "In" rack. On leaving the plant the same procedure is followed, the employee changing his card again to the "Out" rack.

The superintendent can tell by merely glancing at the racks which employees have not yet come in. Employees can register as fast as they can pass in single file. If necessary, additional racks can be added to take care of a larger number of employees than can be accommodated in a single set of "In" and "Out" racks. It is a good rule to make it a severe penalty for one employee to record the time for another employee. The penalty is usually instant dismissal. It is also a good plan to lock the racks 15 minutes after opening time, so that employees will have to go to their foreman and explain the reason for their lateness before beginning work.

The use of these clocks can be extended to record the time of beginning and ending jobs, and the record thus made is the means of finding the exact labor costs of articles and is of great value in establishing an effective cost system.

263. Clock Number Card.— When card-recording clocks are used it is necessary to provide some means for keeping a record of the clock number assigned to each employee. In order to keep a record of the employees to whom clock numbers are assigned a card-index system should be used. The procedure followed when assigning numbers is to give a new employee the first open number in his class. For example, in a shoe factory where cutters are assigned numbers from 200 to 499 the first one would be assigned number 200, the next 201, and so on. By this method all cutters' time records automatically fall together because they come in the same class. Other classes of employees in the shoe factory, such as stitchers, lasters, bottomers, and packers would be assigned numbers in the proper groups. When an employee leaves, his number can be reassigned. Clock number cards give the rate paid, if the employee is a day worker.

264. Time-Clock Cards.— Two styles of clock cards which are designed to be used in connection with the time recorder previously described are illustrated in Forms 66 and 67. The cards bear the

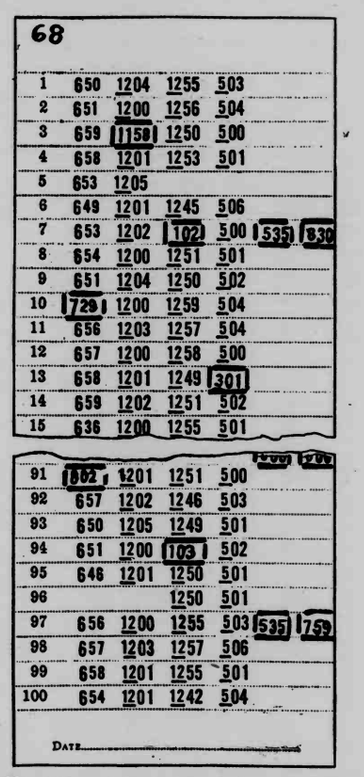
employee's name and clock number. The one shown in Form 66 provides for morning, afternoon, and evening "In" and "Out." At the end of the week the hours worked are extended and the amount earned is then entered in the upper portion of the card as shown.

A special feature of the card shown in Form 67 is the coupon at the top. It is intended that at the end of the week the operative shall detach the coupon and give it to the paymaster on pay day, in exchange for his pay envelope. In the case of day and week workers the clock cards are used as a basis for preparing the payrolls. However, before the amount earned by piece workers can be determined, the piecework tickets have to be checked.

265. Dial Time Recorder.— The Dial Time Recorder is a very popular style of time clock for making a record of the time of entrance and departure of employees for payroll, as well as administrative, purposes. The printing carriage is adjusted to the proper column automatically. The registration is made by moving the pointer to the proper number and pressing it in. The ringing of a bell announces that the registration has been made. The record is printed on a paper slip inside the machine, and shows the time of day the employee enters and leaves the establishment. The standard legends are *"Morning in," "Noon Out," "Noon In," "Evening out," "Night In,"* and *"Night Out,"* but any other series may be had as desired. One advantage of the Dial Time Recorder is that the time-record sheet is locked up inside the case where it cannot be tampered with. There are various styles of these clocks, some of which have a time sheet for a week and some of which only have a strip for a day.

266. Payroll.— The payroll sheet used in a Dial Time Recorder is locked up inside. After being removed from the clock the total hours worked are entered at the right and then extended at the proper rates, in order to obtain the amount due each employee. One feature of this time recorder is the two-color ribbon by means of which all regular records are printed in green and thus require no further inspection, while irregular time and overtime appear in red and are instantly detected by the timekeeper, enabling him to do his work in one-third the usual time. The record may be inspected at any time without removing the time sheet from the case, by simply

looking through the glass doors on either side of the recorder, when the entire record can be plainly seen. It is unnecessary to transcribe the time records, because they are complete in every particular for



68

1	650	1204	1255	503		
2	651	1200	1256	504		
3	659	1158	1250	500		
4	658	1201	1253	501		
5	653	1205				
6	649	1201	1245	506		
7	653	1202	102	500	535	830
8	654	1200	1251	501		
9	651	1204	1250	502		
10	729	1200	1259	504		
11	656	1203	1257	504		
12	657	1200	1258	500		
13	658	1201	1249	301		
14	659	1202	1251	502		
15	636	1200	1255	501		
91	802	1201	1251	500		
92	657	1202	1246	503		
93	650	1205	1249	501		
94	651	1200	103	502		
95	646	1201	1250	501		
96			1250	501		
97	656	1200	1255	503	535	759
98	657	1203	1257	506		
99	658	1201	1255	501		
100	654	1201	1242	504		

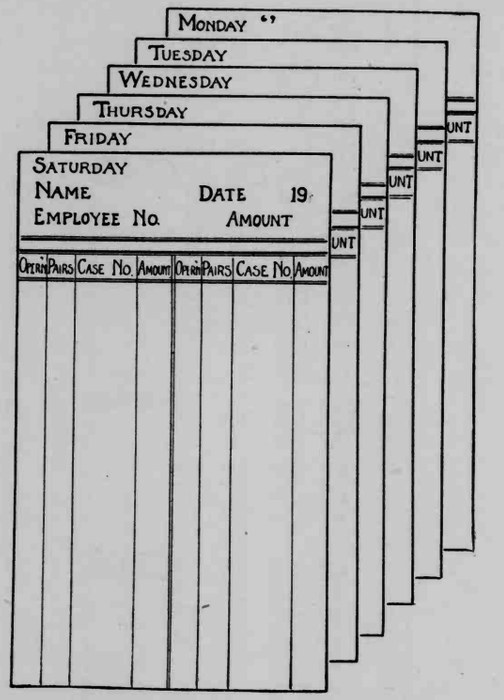
DATE

FORM 68. PAYROLL STRIP FROM DIAL TIME RECORDER

the entire payroll period and can be conveniently filed in a binder for reference. By using this system it is seen how the weekly payroll can be prepared with a minimum of effort. The system gives good results in an office.

267. Payroll Strip.— Dial Time Recorders are manufactured in a variety of sizes, the smaller ones being of the double-drum style and

making a record such as shown on Form 68. The purpose of the double drum is to prevent the detention of the timekeeper, or the party in charge of the machine, to change the time slip after all the employees have registered. The record for the day is made on the drum at the rear of the machine, and the printing carriage then



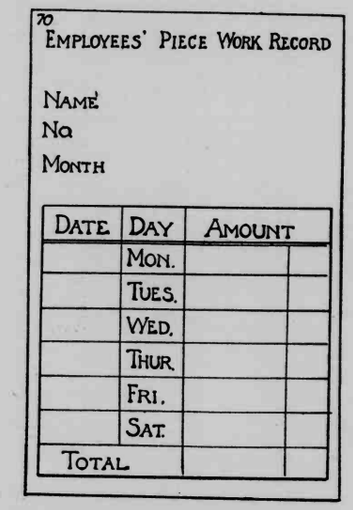
FORM 69. EMPLOYEE'S PIECEWORK RECORD

moves forward to the second drum ready to make the "Morning In" registration for the succeeding day. At any time during the succeeding day the record for the previous day may be removed and a new payroll slip put in.

268. Piecework Records.— In industries where the piecework method of payment prevails the labor cost of an operation is as accurately known before the job is finished as afterwards. Though a

current record of the piecework operations is not required for cost purposes, a means must be provided for maintaining an adequate check on operatives so that they will only be paid for work actually done. Furthermore, special forms are required for use in connection with the piecework system of wage payment. These are illustrated below.

269. Employee's Piecework Record, Front and Back.— The system used in a shoe factory for checking work will be referred to



FORM 70. EMPLOYEE'S PIECEWORK RECORD FOR KEEPING MEMORANDUM OF WEEKLY EARNINGS

in order to explain a common method of auditing pieceworkers' earnings. Form 69 is used by operatives for reporting the amount due them for piecework performed. At the beginning of each week a full set of six tickets is given to each operative. As work is completed on a production order the employee enters the operation number, number of pairs, case number, and amount earned in the spaces provided for the purpose — a separate ticket being used for recording each day's work. At the close of the day the tickets are collected and sent into the office to be checked before being entered on the payroll.

At the back of each of the set of piecework tickets is an "Employee's Piecework Record," shown in Form 70, to be used by the employee for keeping a memorandum of the week's earnings.

270. Checking Card.— A "Checking Card," Form 71, is made out for each case of shoes for which a production order is issued.

71

CHECKING CARD

STOCK No. — CASE No.
No. PAIRS — SIZES — DATE STARTED
SHEET No. — DATE COMPLETED

Oper. No.	Emp. No.	Amount	Oper. No.	Emp. No.	Amount	Oper. No.	Emp. No.	Amount	Oper. No.	Emp. No.	Amount
1			37			71			105		
2			38			72			106		
3			39			73			107		
4			40			74			108		
5			41			75			109		
6			42			76			110		
7			43			77			111		
8			44			78			112		
9			45			79			113		
10			46			80			114		
11			47			81			115		
12			48			82			116		
13			49			83			117		
14			50			84			118		
15			51			85			119		
16			52			86			120		
17			53			87			121		
18			54			88			122		
19			55			89			123		
20			56			90			124		
21			57			91			125		
22			58			92			126		
23			59			93			127		
24			60			94			128		
25			61			95			129		
26			62			96			130		
27			63			97			131		
28			64			98			132		
29			65			99			133		
30			66			100			134		
33			67			101			135		
34			68			102			136		
35			69			103			137		
36			70			104			138		

FORM 71. CHECKING CARD

The purpose of this card is to enable the operative's piecework tickets to be audited, and in addition to maintain a tracing list so that the progress of a lot from one operation to another can be followed readily. As soon as an operative's daily piecework report is received in the office it is given to the checker, who enters the employee's number on the proper checking card opposite the corresponding operation number. This prevents two payments for the same work.

271. Piecework Ticket with Coupon.— A very good plan for obtaining an exact record of the earnings of piece workers is to make use of a piecework ticket, containing coupons such as shown in Form 72. The ticket illustrated is used in an establishment making

72

O

PIECE WORK TICKET NO. 55

ORDER No. — STYLE No.
Mb'se. No. — AMT.
COLOR
OTHER INFORMATION

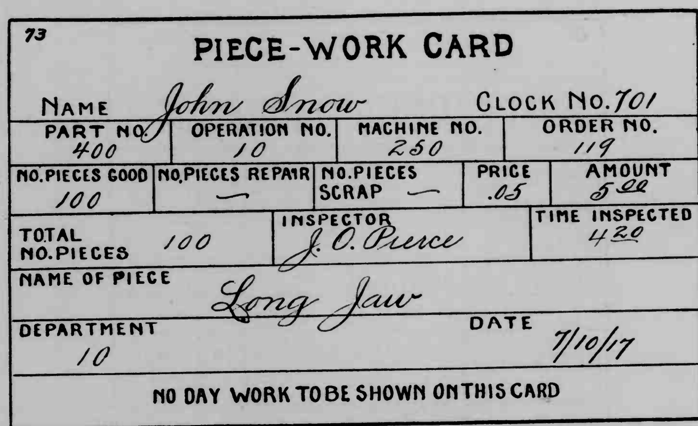
SIZES	28	30	32	34	36	38	40	42	44	46

	Operator Number	Ticket No.	Operation	Style	Amount
PRESS & FOLD		55	Press & Fold		
INSPECT		55	Inspect	STYLE	AMOUNT
TRIM & MEND		55	Trim & Mend	STYLE	AMOUNT
HEM		55	Hem	STYLE	AMOUNT
OVERSEAM		55	Overseam	STYLE	AMOUNT
SEAM		55	Seam	STYLE	AMOUNT
CUT		55	Cut	STYLE	AMOUNT

FORM 72. PIECEWORK TICKET WITH COUPON

bathing suits. When an employee completes work on an operation he detaches the coupon for that operation and enters his number on the stub. At the end of the week each employee turns in his coupons for credit. These are extended and totaled to find the total amount of pay due the operators. This system prevails throughout the garment industries.

272. Piecework Card.— The "Piecework Card," Form 73, shows how the record of the earnings of a pieceworker can be kept in a factory where the inspector certifies the record. Provision is made for recording all the information regarding the work done, as a basis for calculating the amount earned by the employee. It will be noticed that the statement, "No day work to be shown on this



73 PIECE-WORK CARD				
NAME John Snow			CLOCK No. 701	
PART NO. 400	OPERATION NO. 10	MACHINE NO. 250	ORDER NO. 119	
NO. PIECES GOOD 100	NO. PIECES REPAIR —	NO. PIECES SCRAP —	PRICE .05	AMOUNT 5 00
TOTAL NO. PIECES 100	INSPECTOR J. O. Pierce		TIME INSPECTED 4 20	
NAME OF PIECE Long Jaw				
DEPARTMENT 10			DATE 7/10/17	
NO DAY WORK TO BE SHOWN ON THIS CARD				

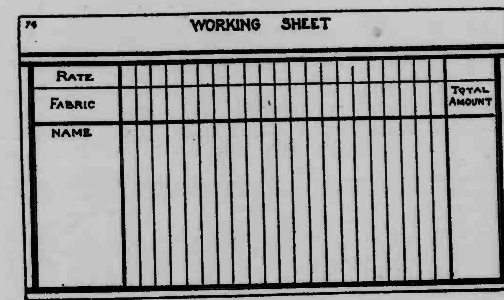
FORM 73. PIECEWORK CARD

card," appears on the bottom of the form. When an individual piecework card is used such as the one shown, it is necessary that any time paid for on an hourly basis be reported on some other form.

There are, of course, a great variety of forms in use for keeping the record of piecework operatives, but those illustrated are suggestive of those generally in use.

273. Working Sheet.— It is frequently necessary to operate columnar "Working Sheets" for the purpose of tabulating and summarizing the earnings of piecework operatives. The style of sheet quite generally used is shown in Form 74, on which provision is made for entering the names of employees on the left, and the rates of pay for different articles across the top. If the sheet is used in a textile mill for computing the earnings of weavers, the method of procedure is to enter the coupons from the loom production orders on the working sheet opposite the employee's name and under the

name of the proper fabric. Then by extending the cuts woven at the respective prices paid, it is an easy matter to find the total earnings for the payroll period.

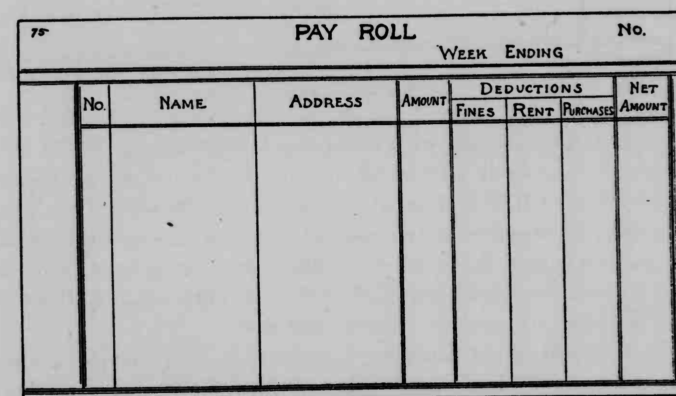


74 WORKING SHEET

Rate		Total Amount
Fabric		
Name		

FORM 74. WORKING SHEET

274. Advance Wage Vouchers.— In some factories it is quite a common practice to make advances to employees. Receipts should be taken for all amounts advanced them on an "Advance Wage



75 PAY ROLL No.
Week Ending

No.	Name	Address	Amount	Deductions: Fines	Deductions: Rent	Deductions: Purchases	Net Amount

FORM 75. PAYROLL

Voucher." When making up the payroll the amount of the voucher should be deducted and only the net amount due put in the pay envelopes of those employees to whom advances against wages have been made.

275. Payrolls.— Payrolls can be prepared either by hand or by means of an addressing machine. The employee's number, name, and address, and amount earned are all to be recorded on the payroll shown in Form 75. When deductions are made for fines, rents, or purchases, they should be shown on the payroll in the columns provided for the purpose. The net amount to be paid is the amount to be drawn from the bank. The payroll illustrated in Form 76 does

76 PAY ROLL PAGE

MONTH OF 19 DEPARTMENT

	Week Ending				Week Ending				Week Ending			
	Emp. No.	Direct	Indirect	Total	Emp. No.	Direct	Indirect	Total	Emp. No.	Direct	Indirect	Total

FORM 76. PAYROLL

away with the necessity of writing employees' names, which is a considerable saving in clerical labor. When it is desired to prepare the weekly payroll, it is inserted in a split keyboard adding machine, the employee's number is first entered and then the amount earned. The amount earned is classified as either direct or indirect labor, in order to make the necessary analysis for cost purposes. A different sheet is ordinarily used for each department.

276. Payroll Sheet Showing Overtime.— When employees are paid at time and a half and double-time rates for working overtime, it is necessary to construct a special form of payroll sheet. Reference to Form 77 shows how a payroll sheet is ruled for use in the composing room of a job-printing establishment. The numbers 1, 1½, and 2 indicate single, time and a half, and double time, respectively. In case time and a half rates are paid after eight hours, and double time after four hours at time and a half or on holidays,

77 PAY ROLL

DEP'T. WEEK ENDED 19

Clock No.	Name	Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Total Direct Hours	Total Indirect Hours	Total Direct Hours	Total Indirect Hours	Total Single Direct Hours	Total Single Indirect Hours	Rate per Week	Rate per Hour	Cost of Direct Hours	Cost of Indirect Hours	Advances	Amount Due
		Direct	Indirect	Direct	Indirect	Direct	Indirect	Direct	Indirect	Direct	Indirect	Direct	Indirect												
		2	1½	1																					
		2	1½	1																					
		2	1½	1																					
		2	1½	1																					
		2	1½	1																					
		2	1½	1																					
		2	1½	1																					
		2	1½	1																					
		2	1½	1																					

FORM 77. PAYROLL SHEET SHOWING OVERTIME

the operative's time would be entered as follows: From 8 A. M. to 12 M. and from 1 P. M. to 5 P. M. the hours worked are entered opposite the employee's name on the line marked with the number one; from 5 P. M. to 10 P. M. the hours worked are entered on the line marked 1½, meaning that time is paid for at one and one-half regular hourly rates; after 10 P. M. or on Sundays the hours worked are entered on the line marked 2, meaning that time is paid for at double regular rates.

It will be seen that provision is made for classifying the hours worked daily under direct and indirect labor headings. The time charged to jobs by compositors, for example, is included under the former, while time not chargeable to jobs is classified as indirect labor. This is an important feature of the payroll sheet used for the composition department in a job-printing establishment. At the end of the week the columns are cross-footed and the totals of direct and indirect hours entered in the columns provided for the purpose at the right of the Saturday column.

The next step is to extend the hours entered on the line marked 1½ by 1½, and the hours entered on the line marked 2 by 2. The result when added to the hours entered on the line marked 1, gives the totals of single direct and indirect hours, respectively. The total single direct and indirect hours have to be extended at the proper hourly rates, and any advances deducted, in order to calculate the amount due each. In case operatives are paid on the basis of a 48-hour week, the weekly rates have to be divided by 48 to get the hourly rates. The direct hours are used as a divisor into the expenses of the department to find the expense per productive hour.

277. Addressograph.— Addressing machines are often used in pay departments for listing employees' names, numbers, and rates on pay sheets, and printing the same on time cards, pay envelopes, etc. The Addressograph is of the "card-index" type, in which the printing is done by means of rubber type or metal plates that have been previously passed under the ink pads. The mechanism is simple and it takes very little practice or skill to get good results. The plates are easily removed or new ones inserted, and the whole set is filed in metal drawers and kept ready for use at any time.

278. Payroll.— The Payroll, in Form 78, has been written by the Addressograph and is all ready to have the hours and amounts

earned filled in. Where a payroll has to be made up for a large number of employees, the use of an Addressograph saves much time.

From the foregoing description of the methods in vogue for keeping employees' records as a basis for preparing payrolls, it is evident that much routine is involved and that the introduction of mechanical aids is a great help in reducing clerical work. Every case has to be studied separately on its own merits, in order to determine just what forms and devices are best suited to meet the needs of the enterprise.

78

PAY ROLL No.

FOR WEEK ENDED 19

No.	NAME	OCCUPATION	RATE	M	T	W	T	F	S	TOTAL HOURS	AMOUNT
1	Long, E.	Oper.	$.30								
2	Horton, R.	Clerk	2000								
3	Conant, B.	Oper.	40								
4	Kirk, S.	Oper.	.37								
5	Tiffany, K.	Oper.	35								
6	Finch, L.S.	Clerk	12.50								
7	Flower, B	Oper.	.40								
8	Gould, A	Oper.	.50								
9	Harris, A.L.	Oper	55								
10	Hastings, J.	Clerk	2250								
11	Burns, P.	Clerk	1800								
12	White, M	Oper.	45								
	TOTAL										

FORM 78. PAYROLL WRITTEN WITH ADDRESSOGRAPH

279. Payroll Analysis Sheet.— The operation of a cost system usually requires that all payrolls be departmentalized. Since there are generally four or five payrolls during each cost period charged to the Payroll account, it is necessary to break up the total of the payrolls by departments. The most convenient way to do this is to use a "Payroll Analysis Sheet," which should be columnar in form. The names of the departmental classifications appear in the column headings. In order to prepare the analysis, reference must be made to the original documents. Under favorable conditions all that is necessary is to transfer the weekly department totals to the Analysis Sheet. In some cases, in which the names on the payrolls are not departmentalized, it is necessary to set down in the proper column the amount paid each employee. In plants where productive operatives perform some non-productive operations reference must be made to the daily time reports of individual operatives. The form used for the Analysis Sheet may provide for hours as well as amounts, if the hours are required either for cost or statistical purposes. A Payroll Analysis Sheet for a newspaper would appear as follows:

Week ended	Administration	Editorial Department	Advertising Department	Circulation Department	Composing Room	Press Room	Total
Jan. 3	$1,250	$2,000	$2,800	$1,800	$3,100	$1,200	$12,150
10	1,200	2,700	4,000	2,100	4,250	1,400	15,650
17	1,275	2,550	3,500	1,950	4,000	1,500	14,775
24	1,300	2,675	4,100	2,000	3,975	1,350	15,400
31	1,250	3,000	3,000	2,250	4,200	1,400	15,100
Total	$6,275	$12,925	$17,400	$10,100	$19,525	$6,850	$73,075

280. Payroll Analysis.— In the mechanical and allied industries it is usually necessary to make an analysis of the payroll to know the amount of direct and indirect labor by departments. The most convenient means of accomplishing this is to fill out a sheet such as the one shown in Form 79. Each week the payroll is distributed under the proper departmental classifications, and then at the end of the cost period the Payroll Analysis Sheet is totaled. By this means the departmentalization of the payroll for cost purposes is accomplished. The direct labor is charged to the Work in Process account and the indirect labor to the Overhead Expense account. Such an

analysis as that shown for a phonograph factory in Form 79 is required for every job-order factory cost system.

281. Summary.— Properly prepared payrolls are needed as a basis for disbursing salaries and wages to employees. Payroll forms

79

THE A.B. PHONOGRAPH CORPORATION
NEWARK WORKS
PAY ROLL ANALYSIS
FOR WEEKS ENDED 19

CLASSIFICATION	DEPARTMENT	TOTAL	1ST WEEK	2ND WEEK	3RD WEEK	4TH WEEK	5TH WEEK
DIRECT LABOR	100 TOOL ROOM						
	200 MACHINE ROOM						
	300 PRESS ROOM						
	400 HAND SCREW MACH.						
	500 AUTO SCREW MACH.						
	600 GEAR CUTTING						
	700 TUBE BENDING						
	800 NICKEL PLATING						
	900 POLISHING AND BUFFING						
	1000 MULTIPLYING REELS						
	1100 FISHING REELS						
	1200 TONE ARM						
	1300 TELESCOPE TONE ARM						
	1400 SOUND BOX						
	1500 MOTOR SPRING						
	1600 MOTORS						
	1700 TURN TABLES						
TOTAL DIR. LABOR							
INDIRECT LABOR	110 TOOL ROOM						
	210 MACHINE ROOM						
	310 PRESS ROOM						
	410 HAND SCREW MACH.						
	510 AUTO SCREW MACH.						
	610 GEAR CUTTING						
	710 TUBE BENDING						
OPERATING	810 NICKEL PLATING						
DEPARTMENTS	910 POLISHING AND BUFFING						
	1010 MULTIPLYING REELS						
	1110 FISHING REELS						
	1210 TONE ARM						
	1310 TELESCOPE TONE ARM						
	1410 SOUND BOX						
	1510 MOTOR SPRING						
	1610 MOTORS						
	1710 TURN TABLES						
	3010 REPAIR						
	3110 POWER						
	3210 BUILDING AND OCCUPANCY						
MISCELLANEOUS	3310 DRAFTING						
	3410 INSPECTION						
DEPARTMENTS	3510 PACKING AND SHIPPING						
	3610 R.M. RECS. AND STORES						
	3710 PROCESS STORES						
	3810 OUTSIDE TRUCKING						
	3910 GENERAL						
TOTAL IND. LABOR							
TOTAL PAY ROLL							

have to be adapted to meet the requirements of whatever wage systems are in vogue. Special checking or coupon systems should be used to control payments to piece workers. Where large numbers of workers are employed mechanical aids should be introduced to expedite the work of preparing payrolls. For cost work it is usually

FORM 79. PAYROLL ANALYSIS

necessary to analyze the payroll into departments. In job-order plants a further division between direct and indirect labor is generally required.

QUESTIONS ON CHAPTER XX

1. What is the need for a system of time-keeping?
2. What is the purpose of keeping records of employees?
3. What time-keeping systems are most in use?
4. How is a Card Time Recorder operated?
5. How is a Dial Time Recorder operated?
6. How is the payroll prepared when a Dial Time Recorder is used?
7. What special forms are required when the piecework system is used? Give an example.
8. How is the piecework checking card operated?
9. How are coupon piecework tickets operated?
10. What use is made of advance-wage vouchers?
11. What mechanical means can be introduced to facilitate the preparation of the payroll?
12. In case it is desired to introduce a bonus wage system in a wooden-box factory and pay operatives in the mill, cutting, and nailing departments a premium based on the number of 1,000 board feet cut in excess of a certain standard quantity, what records would be required in order to make up the payroll?
13. If table-workers in a pamphlet bindery are paid for hand folding at a certain rate per 1,000 sheets folded, what records are required for the purpose of making up the payroll?
14. What records would you install for payroll purposes in the opening department of a cocoanut factory where a contractor takes the contract for opening and shaving cocoanuts at a certain rate per 100 cocoanuts and employs his own helpers?

CHAPTER XXI

LABOR COSTS

282. Labor Cost Records.— The introduction of a complete cost system into a factory usually requires the keeping of certain records in addition to those needed solely for payroll purposes. In order to ascertain the labor cost on all jobs in plants where operatives are employed by the hour, it is necessary to ascertain the elapsed time on each job. Since there are several methods in vogue for obtaining the labor cost on jobs, some of the typical forms and time stamps used will be explained in this chapter.

283. Daily Time Sheets vs. Individual Job Cards.— When introducing a system for keeping the time on jobs in a factory, one of the first matters is to determine whether to use a daily time sheet for keeping a record of how each operative spends his time, or whether to use a separate card for recording the time spent on each job. To indicate the advantages as well as disadvantages in each plan, the forms used and procedure followed in each case will be explained.

284. Daily Time Report.— A large number of the standard cost-finding systems adopted by manufacturers' associations recommend the use of a "Daily Time Report," such as shown in Form 80, for finding out the time operatives spend on each job, and also the time spent on non-productive work. Where such time sheets are used, it is the practice to have the operatives themselves record the time "Commenced" and time "Finished" on each job or non-productive labor classification. Form 80 is used in an instrument-making factory. At the close of the day the time sheets are sent into the office where they are compared with the clock records to see if the full time has been accounted for, after which the productive and non-productive time is extended into columns at the right-hand side.

Time chargeable to job-order numbers has to be posted to the job cost sheets and the non-productive time to the proper expense account according to how the time was spent. In order to facilitate the distribution of non-productive time, it is quite usual to have a set of

symbols indicating various classes of non-productive work printed on the back of the time sheet. The operative is then required to refer to these when classifying his time. This is a necessary part of the

80

DAILY TIME REPORT

NAME _____ DATE _____

TIME STARTED _____ TIME FINISHED _____

Job No.	Part No.	Kind of Work	Ending Time		Used Time		Number of Pieces	Machine Number	For Office Use Only	
			H.	M.	H.	M.			Pro.	N. Pro.

FORM 80. DAILY TIME REPORT

81

Production Order No.	Quantity	Part No.	Operation
Employee	Date	Department	Foreman

BE ACCURATE. YOUR PAY IS MADE UP FROM THESE CARDS.
ON COMPLETION OF OPERATION, THE FINAL LABOR CARD MUST GO TO THE FOREMAN WITH WORK.
ALL OTHER LABOR CARDS ARE TO BE DEPOSITED IN BOXES PROVIDED FOR THEM.
DESCRIBE OPERATION IF NUMBER HAS NOT BEEN GIVEN IT IN SCHEDULE.

6 | 1/4 | 1/2 | 3/4 | 7 | 1/4 | 1/2 | 3/4 | 8 | 1/4 | 1/2 | 3/4 | 9 | 1/4 | 1/2 | 3/4 | 10 | 1/4 | 1/2 | 3/4 | 11 | 1/4 | 1/2 | 3/4 | 12

12 | 1/4 | 1/2 | 3/4 | 1 | 1/4 | 1/2 | 3/4 | 2 | 1/4 | 1/2 | 3/4 | 3 | 1/4 | 1/2 | 3/4 | 4 | 1/4 | 1/2 | 3/4 | 5 | 1/4 | 1/2 | 3/4 | 6

Hours	Pieces	Rate	Amount

FORM 81. INDIVIDUAL JOB TIME TICKETS

routine in order to inform the superintendent with the reason why non-productive time occurs.

285. Individual Job Time Ticket.— Many accountants prefer "Individual Job Time Tickets," shown in Form 81, for obtaining

a record of the time each operative spends on a job. The one illustrated is designed to be used for recording the time spent on jobs in quarter-hour intervals, although some time cards show shorter intervals, as five or six minutes. Every time a job is started an operative or the factory time clerk must make out a ticket. The information at the top is filled in and on the vertical line below the time when the job is started is marked with an "X." When work on the job is completed the time is indicated by making another "X" and a line drawn connecting both crosses, in order to indicate the elapsed time on the job. At the end of the day all operatives' time tickets are sent to the office, where they have to be compared with the clock records, after which they are extended and the value of the time entered at the bottom of the card in the space provided for that purpose. The next step is to file these cards by job-order number. Then when a job is reported finished the time tickets are removed and totaled to give the labor cost on the job. By this means the cost of labor chargeable to any job is easily obtained. The method is simpler in use than the one previously described in which daily time sheets are operated to obtain a record of time spent on jobs. However, it is not as easy to check up the individual cards turned in at the end of each day, to see if all time has been accounted for, as it is in the case where sheets are used. The use of individual-job time tickets requires more supervision than the use of the daily sheet.

286. Decimal System of Time Recording.— If the time of starting and finishing work on jobs is recorded in hours and minutes, it is not as easy to make subtractions for the purpose of determining the elapsed time on jobs as it is if the hour is divided into decimal parts. Another advantage of the method of reporting time in hours and tenths or hundredths is that it makes it much easier to make extensions. The plan of using decimal fractions of the hour is much in vogue and will be explained in detail. This method can be used whether records are written by hand or printed by a time stamp. The table overleaf illustrates the methods of expressing time.

The particular decimal fraction used must depend upon its closeness to the exact time desired. One-tenth hour is equivalent to six minutes; five-hundredths of the hour to three minutes. Experience indicates that in most instances the decimal fraction of one-tenth hour is the most practical.

DIFFERENT METHODS OF EXPRESSING TIME

Imprint of time if hour and minute basis is used.	Imprint of time if hour and five-hundredths of hour basis is used.	Imprint of time if hour and tenth of hour basis is used.
A. M. 7 00	A. M. 7.00	A. M. 7.0
A. M. 7 01	A. M. 7.00	A. M. 7.0
A. M. 7 02	A. M. 7.00	A. M. 7.0
A. M. 7 03	A. M. 7.05	A. M. 7.0
A. M. 7 04	A. M. 7.05	A. M. 7.0
A. M. 7 05	A. M. 7.05	A. M. 7.0
A. M. 7 06	A. M. 7.10	A. M. 7.1
A. M. 7 15	A. M. 7.25	A. M. 7.2
A. M. 7 30	A. M. 7.50	A. M. 7.5
A. M. 7 45	A. M. 7.75	A. M. 7.7
A. M. 8 00	A. M. 8.00	A. M. 8.0
A. M. 8 03	A. M. 8.05	A. M. 8.0
A. M. 8 06	A. M. 8.10	A. M. 8.1
etc.	etc.	etc.

287. Operative's Time Ticket.— A time ticket designed to record the elapsed time spent on a job by means of hours and tenths

OPERATOR'S TIME TICKET

DATE — JOB NO. 1

OPERATION *Cleaning* — STYLE NO.

EMPLOYEE'S NO. *10* — COLOR *Black*

QUANTITY	ELAPSED TIME	TIME RATE	PIECE RATE	AMOUNT
10 LBS.	7½ HRS.	.12½ HR.	DOZ.	$ .94

HOUR	00	06	12	18	24	30	36	42	48	54
8	●	79	78	77	76	75	74	73	72	71
9	70	69	68	67	66	65	64	63	62	61
10	60	59	58	57	56	55	54	53	52	51
11	50	49	48	47	46	45	44	43	42	41
1	40	39	38	37	36	35	34	33	32	31
2	30	29	28	27	26	25	24	23	22	21
3	20	19	18	17	16	15	14	13	12	11
4	10	9	8	7	6	●	4	3	2	1/0

FORM 82. OPERATOR'S TIME TICKET

is shown in Form 82. The working day is divided into eight hours of 10 six-minute intervals each, thereby making 80 intervals which are numbered on the card as shown. The system of numbering is as follows:

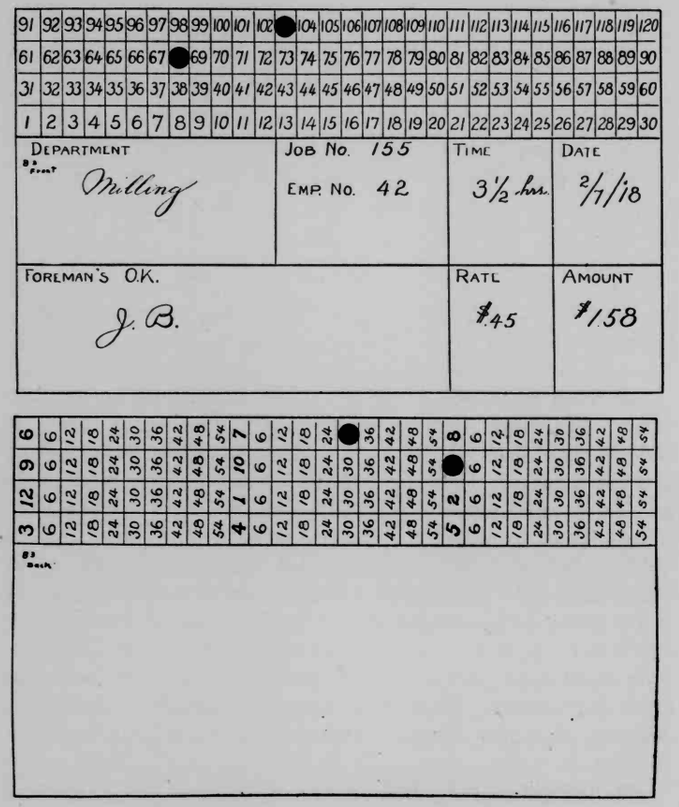
NUMBER SYSTEM OF OPERATIVE'S TIME TICKET SHOWING ELAPSED TIME

	Time	Number of Six-Minute Intervals
A.M.	8.00	80
	8 06	79
	8.12	78
	8.18	77
	8.24	76
	8.30	75
	8.36	74
	8.42	73
	8.48	72
	8.54	71
	etc.	etc.
P. M.	4.00	10
	4.06	9
	4.12	8
	4.18	7
	4.24	6
	4.30	5
	4.36	4
	4.42	3
	4.48	2
	4.54	1
	5.00	0

The lunch hour from 12 m. to 1 p. m., is deducted on the time ticket. The reason for this arrangement of numbers is that it is easier in figuring the elapsed time to subtract a smaller number from a larger number. Thus, for example, if an operative starts on a job at 6 a. m. he punches the card opposite the hour and under the "No Minutes" column in the square marked 80 as shown. If he finishes work at 4:30 p. m., the ticket would be punched in the square marked 5. Subtracting 5 from 80 we obtain 75 tenth-hours, or 7½ hours, for the elapsed time on the job. In the case cited the operative's rate is $0.12½ per hour which extended by 7½ hours gives $0.94 as the labor cost. This plan is superior to the one using hours and minutes. Since there are various methods in vogue for designing these time tickets, reference will be made to another style of ticket.

288. Individual-Job Time Ticket.— Another design of individual time card is shown in Form 83, front and back. The reverse side is used for punching because the time is shown there. Reference to Form 83 (reverse side) will show that the day from 6 a. m. to 6 p. m. is divided into 12 hours of 10 parts each, making 120 units in all. These units are numbered on the front side of the time card beginning with 120 in the upper right-hand corner and ending with 1 in

the lower left-hand corner as shown. When the time of starting and finishing a job is punched on the reverse side of the time ticket, the elapsed time can be ascertained by turning the card over and sub-



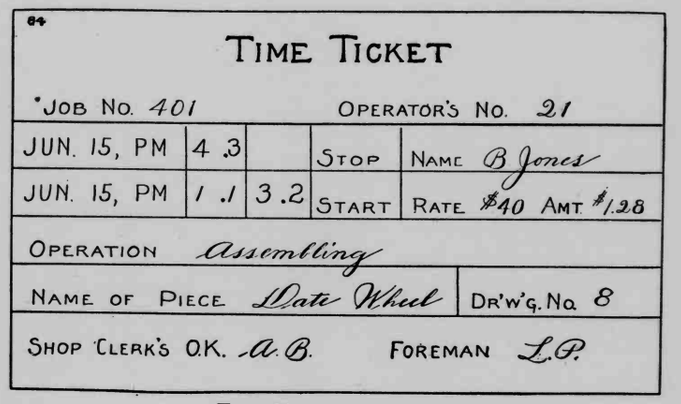
FORM 83. INDIVIDUAL JOB TIME TICKET, FRONT AND BACK

tracting the smaller unit from the larger, as in the previous case. For example, a card punched at 7:30 a. m. and 11 a. m. would show punched on the front side the numbers 105 and 70, the units at the beginning and end of the job. The elapsed time is therefore 35 six-

minute intervals, or 3½ hours. After the elapsed time spent on jobs has been calculated, it is necessary to check up the time tickets in order to see that the full time shown by the clock records has been reported.

After this the time is extended and the cards filed by job-order numbers pending the completion of the jobs. Then they are removed and the labor cost summarized for entry on the job cost sheet.

289. Mechanical Aids.— When introducing a timekeeping system in a plant, it is desirable to consider what mechanical aids can



FORM 84. JOB TIME TICKET

be installed to save clerical work on the one hand and to promote accuracy on the other. There are several types of time stamps in use, and reference will be made to some of them, and to the forms used in connection with them. These devices are designed to record time by printing either hours and minutes or hours and tenths.

290. Electric Time Stamp.— A common type of Electric Time Stamp prints the time on a card. After the time record has been made for an operation, it is necessary to subtract the time finished from the time started in order to find the elapsed time.

The advantage that arises from using this system of mechanical registration is greater accuracy. The time-printing mechanism cannot be tampered with, as it cannot be touched or reached in any man-

ner except by unlocking and opening the machine. It is practically impossible for the time imprints not to be printed in the correct spaces on the work tickets, if the cards are properly inserted. The printing mechanism will make a clear imprint of the time each time the printing lever is pressed.

To illustrate the operation of this machine, we will assume that a manufacturing plant begins regular operations at 7 a. m., the lunch period is from 12 m. to 12:30 p. m., and, if there is night work or overtime, the supper time is from 5 p. m. to 6 p. m. If the unit of time used is the hour and tenths of hour:

When Actual Time of Day Is	Imprint from the Recorder Will Read	
7 A. M.	0.0	
7:05 A. M.	0.0	
7:06 A. M.	0.1	
7:11 A. M.	0.1	
7:12 A. M.	0.2	
8:00 A. M.	1.0	
8:06 A. M.	1.1	
12:00 Noon	5.0	Recorder stopped during lunch
12:30 P. M.	5.0	
12:36 P. M.	5.1	
3:00 P. M.	7.5	
3:30 P. M.	8.0	
5:00 P. M.	9.5	Recorder stopped during supper period
6:00 P. M.	9.5	
6:06 P. M.	9.6	
12:00 Midnight	15.5	
4:24 A. M.	19.9	
4:30 A. M.	0.0	

If an operation is started at 7.02 A. M., the imprint made by the Recorder will show 0.0
If stopped at 3 P. M., the imprint will show 7.5

The actual working time is the difference 7.5

Or seven and one-half hours, from which the lunch period of one-half hour does not have to be deducted.

If an operation is started at 8.07 A. M., the imprint made by the Recorder will show 1.1
If stopped at 9.12 P. M., the imprint will read 12.7

The actual working time is the difference 11.6

Or 11 6/10 hours, from which the half hour for lunch and the one hour for supper do not have to be deducted.

Special forms, of course, need to be devised for use in connection with this Time Stamp. Two of these are shown.

291. Job Time Ticket.— Form 84 shows how a time ticket which is designed to be used with the Electric Time Stamp looks after the record has been made. The elapsed time is shown to be 3.2 hours,

85 MAR. 18	1 .5	TIME	USED	STOP	JOB NO.	MAN'S NO.	RATE	LAB. COST
MAR. 18	0 .0	1	5	START	20	1	.30	.45
MAR. 18	3 .7	TIME	USED	STOP	JOB NO.	MAN'S NO.	RATE	LAB. COST
MAR. 18	1 .5	2	2	START	22	1	.30	.66
MAR. 18	5 .4	TIME	USED	STOP	JOB NO.	MAN'S NO.	RATE	LAB. COST
MAR. 18	3 .7	1	7	START	30	1	.30	.51
MAR. 18	6 .3	TIME	USED	STOP	JOB NO.	MAN'S NO.	RATE	LAB. COST
MAR. 18	5 .4		9	START	37	1	.30	.27
MAR. 18	8 .4	TIME	USED	STOP	JOB NO.	MAN'S NO.	RATE	LAB. COST
MAR. 18	6 .3	2	1	START	41	1	.30	.63
MAR. 18	9 .5	TIME	USED	STOP	JOB NO.	MAN'S NO.	RATE	LAB. COST
MAR. 18	8 .4	1	1	START	45	1	.30	.33
MAR. 18	10 .0	TIME	USED	STOP	JOB NO.	MAN'S NO.	RATE	LAB. COST
MAR. 18	9 .5		5	START	50	1	.30	.15
		TIME	USED	STOP	JOB NO.	MAN'S NO.	RATE	LAB. COST
				START				
TOTAL	10 0							$3.00

FORM 85. DAILY TIME TICKET

which is extended at the operative's hourly rate of $0.40 in order to arrive at the labor cost of $1.28 on the job. The function of the time ticket is the same as that of those previously shown, which were written by hand.

292. Daily Time Ticket.— The "Daily Time Ticket," Form 85, illustrates another design of record for use in connection with the Electric Time Stamp. The ticket provides for recording the time

spent on as many as eight different jobs in a single day. If necessary, more than one ticket can be used. The particular feature of Form 85 is the provision made for separating the parts of the ticket along the dotted lines so that the time reported against individual jobs can be brought together. By this means it is possible to check up the total time reported against jobs in order to see if the full time shown by the clock record has been reported, and then the parts of the ticket can be sorted by job numbers like any individual job time tickets in order to obtain the total labor cost by jobs. Because of the number of good features possessed by the daily time ticket, it is very popular and usually gives good results in those job-order factories where used.

293. Calculagraph.— There are many kinds of time stamps used in connection with cost work but none is more ingenious that the Calculagraph. The Calculagraph is a combination time stamp and time calculator. It actually subtracts automatically the elapsed time between the beginning and end of a period, provided it is less than 12 hours, on which account it is frequently referred to as an "elapsed time recorder." The stamp acts as a stop watch, printing its own results. It avoids all errors in the subtraction of one time of day from another. This makes it a valuable device in many different businesses, and one that applies directly to the timing of a workman on a job. The Calculagraph does away entirely with the pencil and card method, and avoids the errors from mental subtraction in the office.

294. Calculagraph Time Card.— One of the most prominent features of the Calculagraph is that it can be used for an indefinite number of workmen at the same time, because the printing mechanism is in two parts, a dial and an arrow. The dials are first printed by the lever at the right. During the interval between any two records, both the dials and arrows revolve with the clock. Now, the arrows alone are printed, and since their position is recorded on the previously printed dial faces, the elapsed time is automatically indicated on the face of the card.

The Time Card, Exhibit W, is specially designed to be used in the Calculagraph. The card in the upper portion of the exhibit is shown as it appears after the right-hand lever is pushed, thereby registering the beginning of the job. The card in the lower left-hand corner

of the exhibit shows how the record looks after the right-hand lever is pulled, thereby printing the dial faces. In the lower right-hand corner of the exhibit the card is shown as it appears after the left-hand lever has been pulled, thereby printing the number of hours and minutes elapsed.

In cost-finding work the use of the Calculagraph saves time, avoids inaccuracy, and makes the construction of the payroll very easy be-

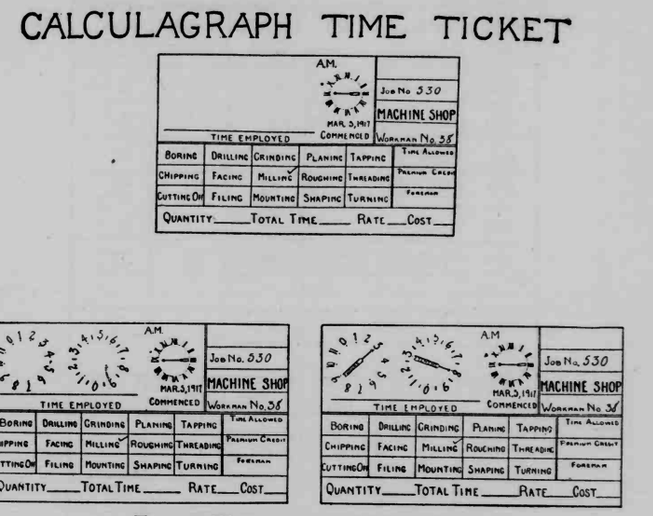


EXHIBIT W. CALCULAGRAPH TIME CARD

cause the time is already calculated and the whole time is simply the sum of the different items.

295. Operative's Time Record.— It is a good plan to keep a statistical record showing the time spent on each operation, as illustrated in Form 86. The record of the time spent by six different employees curling ostrich feather plumes, style 1948, is shown. It will be seen that the time spent varied from 2½ hours to four hours per dozen. Such a record is useful as a basis for fixing piecework rates as well as for administrative purposes. It will be noticed that the best time is made in the morning hours when the operatives

are fresh and that after fatigue sets in the rate of production tends to diminish.

296. Weekly Operation Report, Coats.— There are many factories in which it is not practicable to keep costs on each job, espe-

86

OPERATOR'S TIME RECORD

OPERATION *Curling* STYLE No. 1948

Employee's Number	Time Started	Time Finished	Elapsed Time	Dozens Finished	Time Per Doz.
85	10.00 A.M.	5.00 P.M.	6. Hr.	2	3. Hr.
80	9.00 A.M.	5.00 P.M.	7.	2	3.5
81	8.00 A.M.	2.24 P.M.	5.4	3	2.7
82	8.30 A.M.	11.00 A.M.	2.5	1	2.5
83	1.00 P.M.	5.00 P.M.	4.	1	4.
84	1.12 P.M.	5.00 P.M.	3.8	1	3.8

FORM 86. OPERATOR'S TIME RECORD

cially if piecework prevails and, therefore it is necessary to prepare some sort of statistical record such as the "Weekly Operation Report of Coats," shown in Form 87. This is the report used in the coat shop of a garment making factory and shows the average cost per

coat for each payroll division. This is a valuable administrative guide because it shows the trend in labor costs from one week to another. Such a report as the one presented can be used under the conditions prevailing in a large number of industries.

87

WEEKLY OPERATION REPORT COATS

WEEK ENDED 19

Pay Roll Division	Amount Paid Week Workers	Amount Paid Piece Workers	Total Amount Paid	Number Employees	Average Paid Employees	Average Cost Per Coat
1 Printing Ticket Sewing, Trimming						
2 Linings						
3 Sleeves						
4 Undercollars						
5 Operating						
6 Underpressing						
7 Basting						
8 Hand Sewing						
9 Shaping						
10 Edge and Offpressing						
11 Cleaning Bushelling						
12 Miscellaneous						
13 Shop Non Productive						
14 Office "						
15 Service "						
Totals						
Total No. Employees		Total Pay Roll		Pay Roll Cost Each		

FORM 87. WEEKLY OPERATION REPORT OF COATS

297. Summary.— From the foregoing description of the forms and time stamps used to obtain a record of the elapsed time spent on jobs it will be seen that considerable routine is involved. It is the usual practice to put into operation a system of daily time sheets or individual-job time tickets for the purpose of obtaining the exact amount of time operatives spend on jobs. The use of time stamps is an aid in obtaining an exact record of the time chargeable against job-order numbers. Each plant must be studied carefully to determine just what forms and devices are best suited to meet its individual needs.

QUESTIONS ON CHAPTER XXI

1. What special forms must be introduced into a plant when an attempt is made to obtain the time spent by operatives on individual jobs?
2. Give an example showing how the record of an operative's time is kept on different jobs.
3. What is meant by the decimal system of time reporting? Give an example showing how the system is operated. What are its advantages and disadvantages?

4. What mechanical aids can be introduced for the purpose of recording the time spent by operatives on jobs?
5. What kind of a time recorder automatically subtracts the "time started" from the "time finished"? How does the device work?
6. What statistical records are sometimes desirable to keep regarding employees' time?
7. Devise a form to be used for keeping a record of the efficiency of office employees. This record is to be used as a guide in increasing salary rates of compensation.
8. How would you obtain the time of operatives actually spent on jobs for customers or stock separately from that on repair work and lost time due to idleness?
9. Of what use is a time-recording device in an office where employees are working on a salary basis?
10. What purpose is served by a bonus for punctuality and attendance?

CHAPTER XXII

COST ARITHMETIC CONNECTED WITH LABOR EXPENDITURES

298. Local Conditions Affecting Cost Calculations.— The method of wage payment in vogue determines to a large extent how the labor cost calculations must be made. Nevertheless, certain conditions are found in different factories which affect the mode of procedure requisite for making calculations. To illustrate the influence of such conditions, reference will be made to several concrete cases.

299. Slide Rule for Reducing Regular Time, Over-Time, and Double Time to Single Hours.— The custom of paying operatives at time and a half and double-time rates for working in excess of regular time is quite common. When this practice is pursued it is necessary for payroll purposes to reduce the regular-time, over-time, and double-time worked by operatives to *single hours*. The most convenient method of performing the arithmetical calculations involved is to use a specially constructed slide rule such as shown in Exhibit X. There are four scales shown in the rule. These are lettered W, X, Y, and Z. Regular time is read on the Z scale, overtime or time and one-half, on the Y slide, double time on the X slide, and the total single hours for which the operative is paid on the W scale. The numbers represent hours, and the marks between the numbers divide the hours into quarter-hour intervals. The length of the spaces between hours on the Y slide are one and one-half times the length of those between the hours on the Z slide, and the spaces between hours on the X slide are twice as long as those between hours on the Z scale. The lengths between hours on the W scale are the same as those between hours on the Z scale. The answer is read on the W scale which shows the total single hours for which an employee should be paid. The working out of an example will make the operation of the slide rule clear.

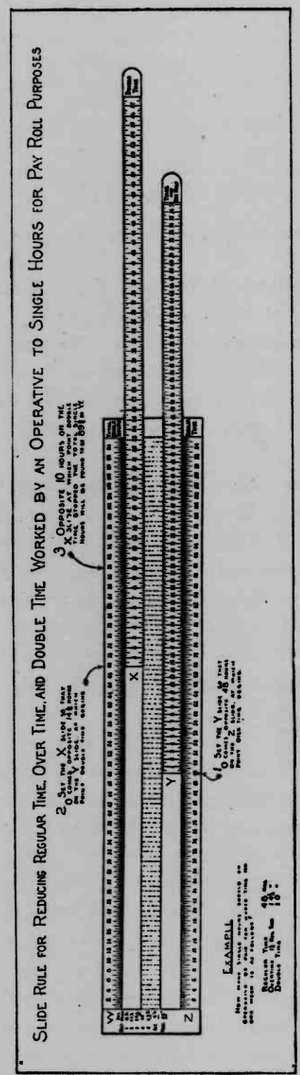


EXHIBIT X. SLIDE RULE FOR REDUCING REGULAR TIME, OVER TIME AND DOUBLE TIME WORKED BY AN OPERATIVE TO SINGLE HOURS FOR PAYROLL PURPOSES

EXAMPLE: For how many single hours should an operative be paid whose time for one week is as follows:

Regular time	48	hours
Overtime (1½ regular time)	14½	hours
Double time	10	hours

Solution

1. Set the Y slide so that O comes opposite 48 hours on the Z slide, at which point overtime begins.
2. Set the X slide so that O comes opposite 14½ hours on the Y slide, at which point double time begins.
3. Opposite 10 hours on the X slide, at which point double time stopped, the total single hours will be found to be 89¾ on W.

Thus, one sees that by setting the slides X and Y in the proper position the total single hours for which an employee should be paid can be read at once.

300. Payroll Calculation Sheet.— Where operatives are paid by the hour it simplifies the work of calculating the labor cost if a "Payroll Calculation Sheet," as shown in Form 88, is first prepared. Hourly wage rates prevailing in the factory are shown in the various headings to the vertical columns, and underneath them are shown the amounts earned in proportion to different lengths of time. By referring to this sheet one can easily calculate for payroll purposes either the amount earned by an employee or the labor cost chargeable to an individual job.

Suppose, for example, that the daily time sheet of an employee receiving $0.32½ an hour shows that he spent his time as follows during the day:

Job No.	Time Spent on Jobs H.	M.
12	3	30
21	2	10
32	0	50
45	1	30
Total	8	00

By referring to the Payroll Calculation Sheet, Form 88, the labor cost chargeable to each job is readily obtained, with the following results:

Job No.	Labor Cost
12	$1.14
21	0.70
32	0.27
45	0.49
Total	$2.60

This is correct, as 8 hours at $0.32½ equals $2.60.

Payroll calculation sheets have to be devised to meet the conditions existing in each plant because hourly rates are bound to vary.

301. **Payroll Calculation Sheet.**— If operatives are employed by the week on a 48 hour basis, it is necessary to arrange the Payroll Calculation Sheet as shown in Form 89. The weekly rates are given in the left-hand columns and the hours worked in the headings of the columns at the right. Thus, if an operative whose rate is $33 a week works 3¾ hours on a job, the labor cost is found opposite $33 and under 3¾ to be $2.58. The sheet has to be made in sections. Form 89 showing that part containing amounts earned at the various weekly rates from ¼ to 5 hours. From 5¼ hours on the amounts earned are shown on other parts of the calculation sheet.

302. **The Calculus.**— When payroll calculation sheets contain a large number of columns, or separate parts, they are awkward to handle and so the expedient is oftentimes adopted of winding the various parts of the calculation sheets on rolls as shown in Exhibit Y. Ten rolls containing a table for five hours on each thus take care of 50 hours. The method of operation consists in turning the proper roll around until the time worked is shown at the top. Then underneath and opposite the rate per hour will be found the amount earned. An example will make the method of operation clear:

EXAMPLE: How much would an operative earn in 28¾ hours at 45 cents an hour?

Solution

1. Turn sixth roll (25¼–30 hours) until 28¾ hours shows at the top.
2. Opposite the 45 cent rate the product of 28¾ hours and 45 cents is found to be $12.94.

This is more convenient than using long sheets and is a time saver for calculating payroll and labor costs.

303. **Piecework Rates.**— Let us next consider how the labor cost may be calculated in a plant where piecework rates prevail. For

88

PAY ROLL CALCULATION SHEET

Elapsed Time	Hourly Wage Rates										
	12½	15	17½	20	22½	25	27½	30	32½	35	40
10	02	03	03	03	04	04	05	05	05	06	07
20	04	05	06	07	08	08	09	10	11	12	13
30	06	08	09	10	11	13	14	15	16	18	20
40	08	10	12	13	15	17	18	20	22	23	27
50	10	13	15	17	19	21	23	25	27	29	33
1 Hr.	13	15	18	20	23	25	28	30	33	35	40
10	15	18	20	23	26	29	32	35	38	41	47
20	17	20	23	27	30	33	37	40	43	47	53
30	19	23	26	30	34	38	41	45	49	53	60
40	21	25	29	33	38	42	46	50	54	58	67
50	23	28	32	37	41	46	50	55	60	64	73
2 Hr.	25	30	35	40	45	50	55	60	65	70	80
10	27	33	38	43	49	54	60	65	70	76	87
20	29	35	41	47	53	58	64	70	76	82	93
30	31	38	44	50	56	63	69	75	81	88	100
40	33	40	47	53	60	67	73	80	87	93	107
50	35	43	50	57	64	71	78	85	92	99	113
3 Hr.	38	45	53	60	68	75	83	90	98	105	120
10	40	48	55	63	71	79	87	95	103	111	127
20	42	50	58	67	75	83	92	100	108	117	133
30	44	53	61	70	79	88	96	105	114	123	140
40	46	55	64	73	83	92	101	110	119	128	147
50	48	58	67	77	86	96	105	115	125	134	153
4 Hr.	50	60	70	80	90	100	110	120	130	140	160
10	52	63	73	83	94	104	115	125	135	146	167
20	54	65	76	87	98	108	119	130	141	152	173
30	56	68	79	90	101	113	124	135	146	158	180
40	58	70	82	93	105	117	128	140	152	163	187
50	60	73	85	97	109	121	133	145	157	169	193
5 Hr.	63	75	88	100	113	125	138	150	163	175	200
10	65	78	90	103	116	129	142	155	168	181	207
20	67	80	93	107	120	133	147	160	173	187	213
30	69	83	96	110	124	138	151	165	179	193	220
40	71	85	99	113	128	142	156	170	184	198	227
50	73	88	102	117	131	146	160	175	190	204	233
6 Hr.	75	90	105	120	135	150	165	180	195	210	240
10	77	93	108	123	139	154	170	185	200	216	247
20	79	95	111	127	143	158	174	190	206	222	253
30	81	98	114	130	146	163	179	195	211	228	260
40	83	100	117	133	150	167	183	200	217	233	267
50	85	103	120	137	154	171	188	205	222	239	273
7 Hr.	88	105	123	140	158	175	193	210	228	245	280
10	90	108	125	143	161	179	197	215	233	251	287
20	92	110	128	147	165	183	202	220	238	257	293
30	94	113	131	150	169	188	206	225	244	263	300
40	96	115	134	153	173	192	211	230	249	268	307
50	98	118	137	157	176	196	216	235	255	274	313
8 Hr.	100	120	140	160	180	200	220	240	260	280	320
10	102	123	143	163	184	204	225	245	265	286	327
20	104	125	146	167	188	208	229	250	271	292	333
30	106	128	149	170	191	213	234	255	276	298	340
40	108	130	152	173	195	217	238	260	282	303	347
50	110	133	155	177	199	221	243	265	287	309	353
9 Hr.	113	135	158	180	203	225	248	270	293	315	360
10	115	138	160	183	206	229	252	275	298	321	367
20	117	140	163	187	210	233	257	280	303	327	373
30	119	143	166	190	214	238	261	285	309	333	380
40	121	145	169	193	218	242	266	290	314	338	387
50	123	148	172	197	221	246	270	295	320	344	393
10 Hr.	125	150	175	200	225	250	275	300	325	350	400

FORM 88. PAYROLL CALCULATION SHEET

purposes of illustration reference will be made to worsted and woolen weaving mills. In order to calculate the labor costs a brief explanation regarding the principles underlying the calculation of piecework rates in weaving mills is necessary.

The rate of production of a fabric depends upon the speed of the loom and the number of picks per inch in the fabric. Filling thread is spoken of as being so many picks per inch and runs crosswise of the fabric while the warp yarn runs lengthwise. Every time the shuttle containing the filling yarns is driven across the loom by the picker stick one pick is inserted in the fabric. From this it is evident that if the shuttles are driven at a constant rate, the quantity of woven fabric will depend upon the number of picks to the inch. A fabric containing 100 threads to the inch in the filling will evidently take just twice as long to weave as one having but 50 picks per inch. Since the piecework rate is based on a standard cut of say 75 yards, a 900 yard warp being cut 12 times for example, it is apparent that the rate must vary directly with the number of threads per inch in the filling, all other things being equal. If a basic fabric has 70 threads to the inch and is paid for at the rate of $1 a cut, the rates for other fabrics can be determined readily, if the number of threads are known.

The basic fabric is woven on a loom with one shuttle, which results in putting but one kind of yarn in the filling. If additional shuttles are used to weave in several more kinds of yarn, care is required on the part of the weaver and so a higher rate per cut has to be paid. Thus, for example each shuttle, in addition to the one used for the basic fabric, is compensated for at the rate of five cents per cut. A fabric woven on a loom using 16 shuttles would, therefore, be paid for at the regular rate plus $0.75 per cut (15×$0.05).

The basic fabric is supposed to be woven on a loom with two harnesses. The harness is the mechanism which actuates the warp yarn, one harness raising some threads while the other depresses the rest of the threads, with the result that as the shuttle is driven across the loom it passes under some of the warp threads and over others. The operation of raising and lowering warp yarns by means of the harnesses is known as shedding. When more than two harnesses are required to weave the design, an additional allowance has to be made to the operative of say five cents per each additional harness. Thus,

PAY ROLL CALCULATION SHEET

48 HOURS PER WEEK

89

PART I

HOURS WORKED ¼ TO 5 HRS.

WEEKLY RATES	¼	½	¾	1	1¼	1½	1¾	2	2¼	2½	2¾	3	3¼	3½	3¾	4	4¼	4½	4¾	5
9	.05	.09	.14	.19	.23	.28	.33	.38	.42	.47	.52	.56	.61	.66	.70	.75	.80	.84	.89	.94
10	.05	.10	.16	.21	.26	.31	.36	.42	.47	.52	.57	.63	.67	.73	.78	.83	.89	.94	.99	1.04
11	.06	.11	.17	.23	.29	.34	.40	.46	.52	.57	.63	.69	.74	.80	.86	.92	.97	1.03	1.09	1.15
12	.06	.13	.19	.25	.31	.38	.44	.50	.56	.63	.69	.75	.81	.88	.94	1.00	1.06	1.13	1.19	1.25
13	.07	.14	.20	.27	.34	.41	.47	.54	.61	.68	.74	.81	.88	.95	1.02	1.08	1.15	1.22	1.29	1.35
14	.07	.15	.22	.29	.36	.44	.51	.58	.66	.73	.80	.88	.95	1.02	1.09	1.17	1.24	1.31	1.39	1.46
15	.08	.16	.23	.31	.39	.47	.55	.63	.70	.78	.86	.94	1.02	1.09	1.17	1.25	1.33	1.41	1.48	1.56
16	.08	.17	.25	.33	.42	.50	.58	.67	.75	.83	.92	1.00	1.08	1.17	1.25	1.33	1.42	1.50	1.58	1.67
17	.09	.18	.27	.35	.44	.53	.62	.71	.80	.89	.97	1.06	1.15	1.24	1.33	1.42	1.51	1.59	1.68	1.77
18	.09	.19	.28	.38	.47	.56	.66	.75	.84	.94	1.03	1.13	1.22	1.31	1.41	1.50	1.59	1.69	1.78	1.88
19	.10	.20	.30	.40	.49	.59	.69	.79	.89	.99	1.09	1.19	1.29	1.39	1.48	1.58	1.68	1.78	1.88	1.98
20	.10	.21	.31	.42	.52	.63	.74	.83	.94	1.04	1.15	1.25	1.35	1.46	1.56	1.67	1.77	1.88	1.98	2.08
21	.11	.22	.33	.44	.55	.66	.77	.88	.98	1.09	1.20	1.31	1.42	1.53	1.64	1.75	1.86	1.97	2.08	2.19
22	.11	.23	.34	.46	.57	.69	.80	.92	1.03	1.15	1.26	1.38	1.49	1.60	1.72	1.83	1.95	2.06	2.18	2.29
23	.12	.24	.36	.48	.60	.72	.84	.96	1.08	1.20	1.32	1.44	1.56	1.68	1.80	1.92	2.04	2.16	2.28	2.40
24	.13	.25	.38	.50	.63	.75	.88	1.00	1.13	1.25	1.38	1.50	1.63	1.75	1.88	2.00	2.13	2.25	2.38	2.50
25	.13	.26	.39	.52	.65	.78	.91	1.04	1.17	1.30	1.43	1.56	1.69	1.82	1.95	2.08	2.21	2.34	2.47	2.60
26	.14	.27	.41	.54	.68	.81	.95	1.08	1.22	1.35	1.49	1.62	1.76	1.90	2.03	2.17	2.30	2.44	2.57	2.71
27	.14	.28	.42	.56	.70	.84	.98	1.12	1.27	1.41	1.55	1.69	1.83	1.97	2.11	2.25	2.39	2.53	2.67	2.81
28	.15	.29	.44	.58	.73	.87	1.02	1.17	1.31	1.46	1.60	1.75	1.90	2.04	2.19	2.33	2.48	2.62	2.77	2.92
29	.15	.30	.45	.60	.76	.91	1.06	1.21	1.36	1.51	1.66	1.81	1.96	2.12	2.27	2.42	2.57	2.72	2.87	3.02
30	.16	.31	.47	.63	.78	.94	1.09	1.25	1.41	1.56	1.72	1.88	2.03	2.19	2.34	2.50	2.66	2.81	2.97	3.13
31	.16	.32	.48	.65	.81	.97	1.13	1.29	1.45	1.62	1.78	1.94	2.10	2.26	2.42	2.58	2.75	2.91	3.07	3.23
32	.17	.33	.50	.66	.83	1.00	1.17	1.33	1.50	1.67	1.83	2.00	2.17	2.33	2.50	2.67	2.83	3.00	3.17	3.33
33	.17	.34	.52	.69	.86	1.03	1.20	1.38	1.55	1.72	1.89	2.06	2.23	2.41	2.58	2.75	2.92	3.09	3.27	3.44
34	.18	.35	.53	.71	.89	1.06	1.24	1.42	1.59	1.77	1.95	2.13	2.30	2.48	2.66	2.83	3.01	3.19	3.36	3.54
35	.18	.36	.55	.73	.91	1.09	1.28	1.46	1.64	1.82	2.01	2.19	2.37	2.55	2.73	2.92	3.10	3.28	3.46	3.65
36	.19	.38	.56	.75	.94	1.13	1.31	1.50	1.69	1.88	2.06	2.25	2.44	2.63	2.81	3.00	3.19	3.38	3.56	3.75
37	.19	.39	.58	.77	.96	1.16	1.35	1.54	1.73	1.93	2.12	2.31	2.51	2.70	2.89	3.08	3.28	3.47	3.66	3.85
38	.20	.40	.59	.79	.99	1.19	1.39	1.58	1.78	1.98	2.18	2.37	2.57	2.77	2.97	3.17	3.36	3.56	3.76	3.96
39	.20	.41	.61	.81	1.02	1.22	1.42	1.62	1.83	2.03	2.23	2.44	2.64	2.84	3.05	3.25	3.45	3.66	3.86	4.06
40	.21	.42	.62	.83	1.04	1.25	1.46	1.67	1.87	2.08	2.29	2.50	2.71	2.92	3.12	3.33	3.54	3.75	3.96	4.17
41	.21	.43	.64	.85	1.07	1.28	1.50	1.71	1.92	2.14	2.35	2.56	2.78	2.99	3.20	3.42	3.63	3.84	4.06	4.27
42	.22	.44	.66	.88	1.09	1.31	1.53	1.75	1.97	2.19	2.41	2.63	2.84	3.06	3.28	3.50	3.72	3.94	4.16	4.38
43	.22	.45	.67	.90	1.12	1.34	1.57	1.79	2.02	2.24	2.46	2.69	2.91	3.14	3.36	3.58	3.81	4.03	4.25	4.48
44	.23	.46	.69	.92	1.15	1.38	1.60	1.83	2.06	2.29	2.52	2.75	2.98	3.21	3.44	3.67	3.90	4.13	4.25	4.58
45	.23	.47	.70	.94	1.17	1.41	1.64	1.88	2.11	2.34	2.58	2.81	3.05	3.28	3.52	3.75	3.98	4.22	4.45	4.69
46	.24	.48	.72	.96	1.20	1.44	1.68	1.92	2.16	2.40	2.64	2.87	3.11	3.35	3.59	3.83	4.07	4.31	4.55	4.79
47	.24	.49	.73	.98	1.22	1.47	1.71	1.96	2.20	2.45	2.69	2.94	3.18	3.43	3.67	3.92	4.16	4.41	4.65	4.90
48	.25	.50	.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00

FORM 89. PAYROLL CALCULATION SHEET

a fabric requiring 12 harnesses would be paid for at the usual rate plus $0.50 (10× $0.05), all other things being equal. Now let us see how this works out in practice.

EXAMPLE: What is the piecework rate per cut for the following fabrics?

Name	Number of Picks per Inch	Number of Shuttles Used	Number of Harnesses Used
Oxford mixed	100	8	4
Shelton weave	120	6	6
Elton novelty	140	10	10

Solution

Fabric	Rate for Weaving	Add for Extra Shuttles	Add for Extra Harnesses	Total Piece
Oxford mixed	$1.43	$0.35	$0 10	$1.88
Shelton weave	1.71	0.25	0.20	2.16
Elton novelty	2.00	0.45	0.40	2 85

The rate for weaving is found by proportion. For the Oxford weave the calculation is as follows:

$$70 : \$1.00 :: 100 : x$$
$$70x = 100$$
$$x = \$1.43$$

Oxford weave has seven shuttles in addition to the one in the basic fabric making $0.35 to be added to the weaving rate. This fabric also has two harnesses in addition to the two in the basic fabric, thereby making $0.10 more to be added, making $1.88 as the total rate per cut. Other rates are found in a similar manner.

If it is desired to find the labor cost per yard the calculation would be as follows:

Fabric	Piece Rate per Cut	Yards per Cut	Cost per Yard
Oxford mixed	$1.88	75	$0 025
Shelton weave	2.16	75	0.029
Elton novelty	2.85	75	0 038

In the case of a straight piecework rate which does not vary, due to different conditions, there are, of course, no complications encountered in making the calculations, such as was the case in the above example taken from a weaving mill.

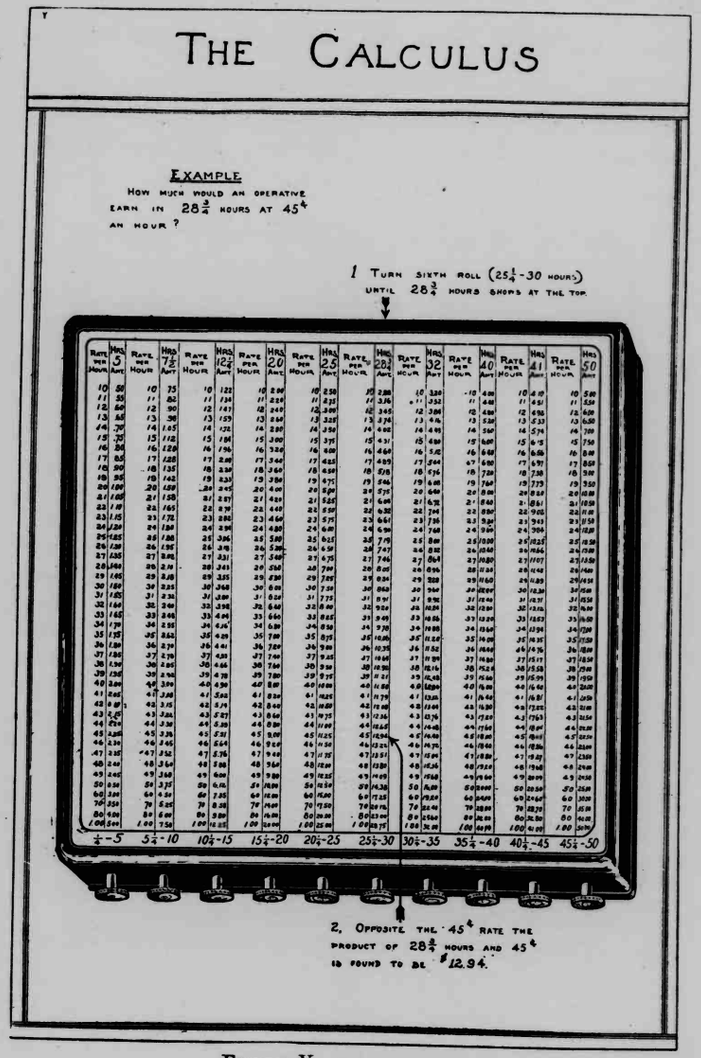


EXHIBIT Y. THE CALCULUS

Let us now see how the payroll would be computed in a weaving mill.

EXAMPLE: What is the amount due weavers for the following work:

John Spinney: 4 cuts Oxford mixed, 2 cuts Shelton weave, 6 cuts Elton novelty.
Frederick Long: 2 cuts Shelton weave, 10 cuts Elton novelty, 1 cut Oxford mixed.
Frank Brown: 10 cuts Elton novelty, 2 cuts Oxford mixed.

Solution

PAYROLL

Name	Fabrics and Piece Rates			
	Oxford Mixed	Shelton Weave	Elton Novelty	Total
	$1.88	$2.16	$2.85	
John Spinney	4	2	6	$28.94
Frederick Long	1	2	10	34.70
Frank Brown	2		10	32.26
Total	7	4	26	$95.90

The conditions which exist in each industry in which piecework prevails must be studied in order to determine the method of calculation to be employed. The work of calculating the labor cost for plants in which piecework prevails is usually less than that for factories in which the differential and premium wage systems prevail.

304. Taylor Differential Piece Rate System.— If different piecework rates are paid, depending upon the number of pieces produced in a given time, it is necessary to make the calculation accordingly. A brief example will make the manner of procedure clear.

EXAMPLE: What is the labor cost of each job worked on by a mechanic in a factory when the following schedule of differential piecework rates is in effect?

DIFFERENTIAL PIECEWORK RATES

Number of Pieces per Hour	Rate per Piece in Cents
10	5.0
11	5.2
12	5.4
13	5.6
14	5.8
15	6.0

The production reported for the day was as follows:

Job Number	Time Spent on Job		Number of Pieces Made
	Hours	Minutes	
42	1	00	12
43	2	00	30
44	1	30	21
45	0	20	5
46	3	00	33
Total..	8	00	

Solution

Job Number	Time Spent on Job		Number of Pieces Made	Number of Pieces per Hour	Piece Work Rate in Cents	Labor Cost
	H.	M.				
42	1	00	12	12	5.4	$0.65
43	2	00	30	15	6.0	1.80
44	1	30	21	14	5.8	1.22
45	0	30	5	10	5.0	0.25
46	3	00	33	11	5.2	1.72
Total..	8	00				$5.64

From the foregoing it is seen how the labor cost is computed on jobs under the Taylor differential wage system. In order to make the calculation a table of rates must be provided showing the different rates corresponding to the number of pieces produced in a given period of time. In the foregoing example the differential is two-tenths of a cent corresponding to each increase of one in the number of pieces per hour over the base rate of $0.05 for 10 pieces per hour.

305. Halsey Premium Wage System.— Let us now turn our attention to the conditions existing in a plant in which the premium wage system of payment prevails and see what procedure must be followed there in making a calculation of labor costs. The Halsey 50 per cent premium wage system will be considered first.

EXAMPLE: What is the labor cost of jobs done by an operative whose rate is $0.30 an hour and who reported his time as follows for a day?

Job Number	Time Taken on Job		Standard Time	
	Hours	Minutes	Hours	Minutes
4	1	00	1	00
7	3	45	4	16
12	1	15	1	30
16	2	00	2	15
Total..	8		9	

Solution

Job Number	Time Taken on Jobs		Amount Earned at 30 Cents per Hour	Time Saved		Premium Time		Amount of Premium	Total Labor Cost
	H.	M.		H.	M.	H.	M.		
4	1	00	$0.30	0	0	0	0	$0.00	$0.30
7	3	45	1.12	0	30	0	15	0.07	1.19
12	1	15	0.38	0	15	0	7½	0.04	0.42
16	2	00	0.60	0	15	0	7½	0.04	0.64
	8	00	$2.40	1	00	0	30	$0.15	$2.55

From the foregoing it is seen that the operative did the work on the four jobs in one hour less than the standard time. According to the Halsey 50 per cent premium plan he is paid his regular rate for the time taken on the jobs plus a premium equal to the value of half the time saved. In eight hours his regular rate gives him $2.40 and on the half-hour premium time he receives an additional allowance of $0.15 making $2.55 for the day as shown.

EXAMPLE: Suppose that the working time and standard time remain the same but that instead of a rate of $0.30 an hour the employee receives $0.40 and the premium instead of being 50 per cent is 33⅓ per cent. What difference would it make in the result?

Solution

Job Number	Time Taken on Jobs		Amount Earned at $0.40 per Hour	Time Saved		Premium Time		Amount of Premium	Total Labor Cost
	H.	M.		H.	M.	H.	M.		
4	1	00	$0.40	0	0	0	0	$0.00	$0.40
7	3	45	1.50	0	30	0	15	0.10	1.60
12	1	15	0.50	0	15	0	7½	0.05	0.55
16	2	00	0.80	0	15	0	7½	0.05	0.85
	8	00	$3.20	1	00	0	30	$0.20	$3.40

From the foregoing it is seen how a change in the hourly rate and premium per cent affect the result. If a premium of 25 per cent were used, the method of calculating the labor cost would be analogous to that followed in the two foregoing cases, in which premiums of 50 and 33⅓ per cent were used.

306. Rowan Premium Wage System.— Reference will next be made to the method of calculating labor costs according to the requirements of the Rowan premium wage system.

EXAMPLE: From the data contained in the following table calculate the labor cost on jobs done by an operative where the hourly rate is $0.40 according to the Rowan system of wage payment.

Job Number	Time Spent on Job		Standard Time Allowance	
	Hours	Minutes	Hours	Minutes
50	1	10	1	17
51	3	30	3	40½
52	0	30	0	33½
53	2	20	2	34
54	0	30	0	32½
Total.....	8	00	8	37½

Solution

Job Number	Time Spent on Job		Standard Time Allowance		Time Saved		Rowan Premium Per cent
	Hours	Minutes	Hours	Minutes	Hours	Minutes	
50	1	10	1	17	0	07	9.1
51	3	30	3	40½	0	10½	4.7
52	0	30	0	33½	0	03½	10.4
53	2	20	2	34	0	14	9.1
54	0	30	0	32½	0	02½	7.7
Total...	8	00	8	37½	0	37½	

LABOR COST

Job Number	Time Spent on Job		Amount Earned at $0.40 per Hour	Rowan Premium Per cent	Premium Earned	Labor Cost
	Hours	Minutes				
50	1	10	$0.47	9.1	$0.04	$0.51
51	3	30	1.40	4.7	0.06	1.46
52	0	30	0.20	10.4	0.02	0.22
53	2	20	0.93	9.1	0.08	1.01
54	0	30	0.20	7.7	0.02	0.22
Total...	8	00	$3.20		$0.22	$3.42

From the foregoing it will readily be seen that the premium is equal to the per cent of the time saved multiplied by the amount earned at the regular rate on the job. In every case when it is required to calculate labor costs under the Rowan system, the standard time must be known in addition to the actual time on the jobs in order that the premium per cent may be obtained.

307. Gantt Task and Bonus System.— The next example presented is taken from a plant where the Gantt task and bonus system of wage payment is in vogue.

EXAMPLE: From the data contained in the following table calculate the labor cost on jobs done by an operative paid at the rate of $0.60 an hour according to the Gantt task and bonus system.

Job Number	Time Spent on Job		Number of Pieces Made
	Hours	Minutes	
60	1	40	15
61	0	40	15
62	0	50	15
63	0	70	15
64	0	80	15
65	0	30	15
66	0	60	15
67	0	50	15

BONUS TABLE

Rate, $0.60 per hour; Standard number of pieces per hour, 15.

Actual Time in Minutes	Bonus per Hour in Cents	Total Rate per Hour in Cents
100	0	60
90	0	60
80	0	60
70	0	60
* 60	24	84
50	26	86
40	28	88
30	30	90

* 40 per cent bonus paid upon reaching the standard.

Solution

Job Number	Time Spent on Job		Total Rate per Hour	Labor Cost
	H.	M.		
60	1	40	$0.60	$1.00
61	0	40	0.88	0.58
62	0	50	0.86	0.71
63	1	10	0.60	0.70
64	1	20	0.60	0.80
65	0	30	0.90	0.45
66	1	00	0.84	0.84
67	0	50	0.86	0.71
Total..	8	00		$5.79

In the foregoing example the number of pieces made on each job was 15. If the operative worked more than one hour, he was paid at his regular rate of $0.60 per hour as indicated by the bonus table, but if he did the work in one hour or less, he was paid at increased rates as shown.

308. Emerson Efficiency Wage System.— Before leaving the subject of labor cost calculations reference will be made to the Emerson efficiency wage system.

EXAMPLE: From the data contained in the following table make a calculation of the labor cost on the jobs done by an operative whose regular rate is $0.60 per hour according to the Emerson efficiency wage system:

	Time Taken on Job		Standard Time	
	H.	M.	H.	M.
70	1	40	1	23
71	2	00	2	00
72	1	40	1	07
73	2	40	3	45
Total...	8	00	8	15

TABLE OF BONUS CORRESPONDING TO EFFICIENCY PER CENT

Efficiency Per Cent	Bonus Per Cent
66⅔	0
71	1.4
77	3.7
83	6.0
91	11.0
100	20.0
111	27.0
125	45.0

Solution

Job Number	Time Taken on Job		Standard Time Allowance		Efficiency Per Cent	Bonus Per Cent
	H.	M.	H.	M.		
70	1	40	1	23	83	6
71	2	00	2	00	100	20
72	1	40	1	07	66⅔	0
73	2	40	3	45	71	1.4
Total	8	00	8	15		

LABOR COST

Job Number	Time Taken on Job		Amount Earned	Bonus Per Cent	Bonus	Labor Cost
	H.	M.				
70	1	40	$1.00	6	$0.06	$1.06
71	2	00	1.20	20	0.24	1.44
72	1	40	1.00	0	0.00	1.00
73	2	40	1.60	1.4	0.22	1.82
Total	8	00	$4.80		$0.52	$5.32

It will be noticed that in making the foregoing calculations of the labor cost on jobs it is first necessary to divide the time taken into the standard time in order to obtain the efficiency per cent; then, by referring to the table the bonus per cent corresponding to the efficiency per cent can be found. In calculating the labor cost the time worked is extended at the operative's hourly rate of $0.60 and then the bonus is added in order to arrive at the labor cost as shown.

309. Summary.— The foregoing calculations of labor costs are indicative of the procedure to be followed in figuring the cost of labor chargeable to jobs for cost purposes on the one hand, and for payroll purposes on the other. After the labor cost has been ascertained it is an easy matter to enter the cost on the job cost sheets as well as on the payroll.

Questions on Chapter XXII

1. What purpose is served by a payroll calculation sheet?
2. In a textile mill what relation do the number of picks per inch bear to the piecework rates? Give an example.
3. Give an example showing how the payroll is made up in a textile mill where piecework is in vogue.
4. Give an example showing how piecework is calculated in a plant where the Taylor differential piecework system is in vogue.
5. Illustrate how labor costs are calculated in a plant in which the Halsey premium wage system is in vogue.
6. Illustrate the operation of the Rowan premium wage system.
7. Show how the Gantt task and bonus system operates.
8. Give an example showing the operation of the Emerson efficiency wage system.

PART V
OVERHEAD EXPENSE

CHAPTER XXIII

INTRODUCTION TO OVERHEAD EXPENSE

310. Expense and Expense Accounts.— In the chapter dealing with the elements of cost, overhead expense was defined as outlay necessary to carry on the business as a whole but difficult to associate directly and exclusively with any particular unit of the output. These expenditures, obviously, are for such general items as management and supervision, power, light, heat, rent, general supplies, depreciation, insurance, and taxes. A particular concern may have any or all of the items just mentioned and also some not included in this list. Two steps must be taken to insure accurate inclusion of all overhead expense when calculating the total cost of some unit of goods or service: proper accounts must be set up in which to make all expense entries, and some system of apportioning the total expense among the units produced must be devised.

It is a simple matter to set up the expense accounts. The concern opens in the ledger the number of these accounts requisite to care for the several forms of expense which it regularly meets. At the end of the month or other financial or cost period, the total expense charge of each sort is readily seen.

The distribution of expense is also simple in certain continuous-process establishments which confine themselves to manufacturing a standard article and have a minimum of selling activity. In a process plant of this sort (we have in mind a sole-leather tannery, a prepared-cocoanut factory, and a bakery) the overhead expenses of manufacture are simply merged with the labor cost and a grand total cost of manufacture is had. This is divided by the number of units produced and the unit cost to make is found. The selling expense is treated in a like simple manner and the cost to make and sell derived. Evidently, there is little difficulty in apportioning, or distributing, the overhead expense in a process factory manufacturing a single product.

But the problem of distribution becomes more complicated as the variety and number of products increase. Hence, the job-order plant has serious problems in this connection, but the process factory, turning out several commodities which use some general departments of the establishment in common yet use other expense departments with varying degrees of intensity or pressure, faces difficulties not obviously resolved. Sometimes it is not worth while to analyze just how much the operations connected with each job add to the several expense accounts and an expedient known as the *establishment of rates* is resorted to in calculating how much overhead each job should properly bear. The cost accountant says that in general a job ought to be charged overhead in this or that respect according to a *rate* determined by the peculiar organization of the plant and past experience. For instance, the rate for manufacturing departments may be an *hourly service charge*. Selling expenses in a factory may be imposed as a burden on each unit of the product as a *percentage of the cost to manufacture* or as a *percentage of the sales*. Various plans of rate-making will be presented later.

311. **Departmentalization of Expense.**— Most factories, whether of the process or job-order type, are departmentalized to a greater or less extent. When several processes or departments are found in operation it is usually necessary to open an Overhead Expense account for each process or department. This means that the elements entering into overhead expense must be allocated to departments. In continuous-process plants it is quite common to charge the expenses of each department direct to the individual process accounts. Thus, in a textile finishing mill operating dyeing, bleaching, and mercerizing departments it is often the practice to charge chemicals, supplies, depreciation, insurance, and taxes direct to the respective accounts opened for the various processes. The accounts may be subdivided in order to meet local needs if desired. One dyeing account would show the total cost of dyeing fabrics Turkey red, and another the cost of dyeing cotton cloth indigo. The cost is divided by the number of yards dyed in the respective processes in order to obtain the cost of dyeing per yard. The cost of performing any process can be found by dividing the number of units of production into the cost of operating the process, as shown by the charges to the Ledger account, for the respective processes.

312. **Conversion Cost.**— If raw material passes through several stages of manufacture in a process factory before it reaches the finished state, the *cost of manufacture* is, of course, equal to the sum of the original raw material used in the product, and the successively incurred department process costs. Thus, in a silk-throwing mill the calculation of the cost must include the cost of the raw silk itself, and the cost of performing the operations known as soaking, winding, spinning, reeling, and bundling. Both the direct and overhead charges for performing the necessary processes to change raw material into a finished product, exclusive of the cost of the raw material, constitute the *cost of conversion*. In this connection one will often hear Minneapolis flour-mill men say that their *cost of conversion* is 50 cents, meaning that the labor and expense required to mill the wheat in a barrel of flour is half a dollar. Sole-leather tanners say that their conversion cost is 10 cents a pound, meaning that the labor and expense incurred in turning raw hides into sole leather is 10 cents per pound. It is useful to speak of *cost of conversion* as a thing by itself because owners of raw materials often keep title to such material and simply pay someone else to convert it into a more finished commodity. This fee obviously would be made up of the cost of conversion plus the converter's profit. The cost of wheat or the cost of green hides has to be added to the cost of conversion in order to arrive at the total cost of manufacturing flour or sole leather. To the cost of manufacture, selling expense must be added in order to obtain the total cost.

313. **Overhead in Job-Order Factories.**— More difficulty is generally experienced in calculating the overhead expense applicable to each unit of the product in job factories than in process plants. The difficulty arises from the fact that the various jobs, or units of the product, do not spend the same time in production, nor draw upon any or all the overhead services in a uniform manner, and consequently some means must be found for assessing overhead expense equitably as a burden on each job. Usually separate accounts are opened for the purpose of determining the amount of expense in each department. Then it is assumed that the amount of expense in any one department should be prorated over the various jobs worked upon in proportion to the time which the various jobs spend in the department, or on some other of a number of reasonable bases to be ex-

plained later. Thus, if the rate for overhead expense is found to be $1 per productive hour in a given department, based on the hours of operatives who charge time directly against orders, and a job was in process 10 hours, the expense on it would be $10. If another job was in process 15 hours, the overhead expense chargeable to it would be $15. The reason for using time as a basis is that the cost of items which enter into overhead expense vary directly with time for the most part. The salaries of the superintendent, foremen, time clerks, inspectors, and others performing the work of supervision, are paid by the week or month. The cost of power, light, heat, supplies, rent, and so on varies in proportion to the length of the cost period. When it is neither convenient nor accurate to use time as a basis, some other basis, logically dictated by the plant organization as more desirable, is used.

314. **Departmental Rates.**— Usually a separate rate for assessing the overhead expense on jobs in *each* department is established when *time* is the basis of rate calculation. The necessity for this arises from the fact that the ratio of expense to productive hours varies in the different departments. In a department where there is a large investment in machinery one usually finds a high overhead rate, while in a department where bench work prevails the overhead expense rate is low. The time that a job spends in each department generally determines how much overhead expense it should bear. Thus, if a job spends 10 hours in Department A, whose overhead rate is $1 and three hours in Department B, whose overhead rate is 50 cents, the total overhead expense on the job is $11.50. The procedure is the same regardless of how long a job is in process, or when a job is finished. The point to remember is that when work is completed on a job the prime cost is calculated and the overhead expense added by means of rates in order to find the cost of manufacture. The method of calculating rates to be used for distributing expense will be more fully explained in Chapter XXVIII. If desired, selling expense can be added to the manufacturing cost in order to get the total cost to make and sell.

315. **Service Departments.**— Not all departments in a plant work directly on the product. Besides the general office department, one will usually find a power, repair, and other so-called service departments, through which material does not pass while undergoing

manufacture. The expense of these departments must, of course, be distributed over the operating departments in order to find the overhead rates to be used for applying expense as a burden on the product. Thus, the total expense of the punch-press department in a machine shop would consist of the direct charges to the department expense account plus a portion of the power, repair, and administration department expenses. It is customary to open whatever service department expense accounts are necessary and then to close out these miscellaneous or auxiliary accounts to the expense accounts of the productive, or operating, departments. The reason for closing the expenses of auxiliary services into operating-department expense accounts is that it is only in a regular production department that the time a job spends in process can be ascertained and rates applied.

316. **Selling Expense.**— It is necessary, as previously stated, to make a distinction between manufacturing and selling expenses. The former class of expenses are assumed to be absorbed by the product during the manufacturing process. The latter class of expenses, comprising the cost of marketing the merchandise, is assumed to be more intimately a charge against the current Profit and Loss account. After merchandise reaches the finished state it can no longer appreciate in value and therefore the cost of merchandising has to be written off to Profit and Loss each period. Under the head of Selling Expense one finds the salaries of salesmen, commissions, traveling expenses, cost of samples, advertising, and other miscellaneous items pertaining to the sales department.

317. **Chart of Expense Account Classifications.**— Expense accounts for a typical job-order plant from one of the mechanical industries would be operated as indicated by the "Chart of Expense Account Classifications" shown in Exhibit Z. Provision is made for five operating-department expense accounts, one selling-department expense account, and four miscellaneous expense accounts. The plan indicated in the chart is to close the miscellaneous, or service department, accounts out to the operating and selling department accounts. Thus, the Repair Department account is distributed to the various operating and selling-department expense accounts on the basis of the amount of repair work done for each. The code numbers are used as a means of indicating to what accounts various expenses are to be charged. If the cost clerk classifies an invoice for

a repair part as being chargeable to Account 1112, one knows that it belongs to Department A Operating Expense under the purchases

CHART OF EXPENSE ACCOUNT CLASSIFICATIONS

DEWEY DECIMAL SYSTEM

1000 MANUFACTURING EXPENSE

DEPT. A OPERATING EXPENSE 1100

- 1110 CURRENT CHARGES
  - 1111 PAY ROLL
  - 1112 PURCHASES
  - 1113 SUPPLIES
  - 1114 REPAIRS
  - 1115 POWER
  - 1116 BUILDING AND OCCUPANCY EXP
  - 1117 GENERAL AND OFFICE EXP
  - 1118 WASTE CREDITS
- 1120 PREPAID AND ACCRUED CHARGES
  - 1121 DEPRECIATION
  - 1122 INSURANCE
  - 1123 TAXES

DEPT. B OPERATING EXPENSE 1200

- 1210 CURRENT CHARGES
  - 1211 PAY ROLL
  - 1212 PURCHASES
  - 1213 SUPPLIES
  - 1214 REPAIRS
  - 1215 POWER
  - 1216 BUILDING AND OCCUPANCY EXP
  - 1217 GENERAL AND OFFICE EXP
  - 1218 WASTE CREDITS
- 1220 PREPAID AND ACCRUED CHARGES
  - 1221 DEPRECIATION
  - 1222 INSURANCE
  - 1223 TAXES

DEPT. C OPERATING EXPENSE 1300

- 1310 CURRENT CHARGES
  - 1311 PAY ROLL
  - 1312 PURCHASES
  - 1313 SUPPLIES
  - 1314 REPAIRS
  - 1315 POWER
  - 1316 BUILDING AND OCCUPANCY EXP.
  - 1317 GENERAL AND OFFICE EXP
  - 1318 WASTE CREDITS
- 1320 PREPAID AND ACCRUED CHARGES
  - 1321 DEPRECIATION
  - 1322 INSURANCE
  - 1323 TAXES

DEPT. D OPERATING EXPENSE 1400

- 1410 CURRENT CHARGES
  - 1411 PAY ROLL
  - 1412 PURCHASES
  - 1413 SUPPLIES
  - 1414 REPAIRS
  - 1415 POWER
  - 1416 BUILDING AND OCCUPANCY EXP
  - 1417 GENERAL AND OFFICE EXP
  - 1418 WASTE CREDITS
- 1420 PREPAID AND ACCRUED CHARGES
  - 1421 DEPRECIATION
  - 1422 INSURANCE
  - 1423 TAXES

DEPT. E OPERATING EXPENSE 1500

- 1510 CURRENT CHARGES
  - 1511 PAY ROLL
  - 1512 PURCHASES
  - 1513 SUPPLIES
  - 1514 REPAIRS
  - 1515 POWER
  - 1516 BUILDING AND OCCUPANCY EXP
  - 1517 GENERAL AND OFFICE EXP
  - 1518 WASTE CREDITS
- 1520 PREPAID AND ACCRUED CHARGES
  - 1521 DEPRECIATION
  - 1522 INSURANCE
  - 1523 TAXES

2000 SELLING EXPENSE

SELLING EXPENSE 2000

- 2010 CURRENT CHARGES
  - 2011 PAY ROLL
  - 2012 PURCHASES AND DISBURSEMENTS
    - 2012.1 COMMISSIONS
    - 2012.2 TRAVELING EXP.
    - 2012.3 ENTERTAINMENT
    - 2012.4 DUES
    - 2012.5 MISC.
  - 2013 SUPPLIES
  - 2014 REPAIRS
  - 2016 BUILDING AND OCCUPANCY EXP
  - 2017 GENERAL AND OFFICE EXP
- 2020 PREPAID AND ACCRUED CHARGES
  - 2021 DEPRECIATION
  - 2022 INSURANCE
  - 2023 TAXES

3000 MISCELLANEOUS ACCOUNTS CLOSED OUT TO OPERATING AND SELLING DEPARTMENT ACCOUNTS

REPAIR DEPT. EXPENSE 3100

- 3110 CURRENT CHARGES
  - 3111 PAY ROLL
  - 3112 PURCHASES
  - 3113 SUPPLIES
  - 3114 MATERIALS
  - 3115 POWER
  - 3116 BUILDING AND OCCUPANCY EXP
  - 3117 GENERAL AND OFFICE EXP
- 3120 PREPAID AND ACCRUED CHARGES
  - 3121 DEPRECIATION
  - 3122 INSURANCE
  - 3123 TAXES

POWER DEPT. EXPENSE 3200

- 3210 CURRENT CHARGES
  - 3211 PAY ROLL
    - 3211.1 ENGINEER
    - 3211.2 FIREMAN
    - 3211.3 COAL PASSER
  - 3212 PURCHASES
  - 3213 FUEL
  - 3214 OILS
  - 3215 SUPPLIES
  - 3216 BUILDING AND OCCUPANCY EXP.
- 3220 PREPAID AND ACCRUED CHARGES
  - 3221 DEPRECIATION
  - 3222 INSURANCE
  - 3223 TAXES

BUILDING AND OCCUPANCY EXP. 3300

- 3310 CURRENT CHARGES
  - 3311 PAY ROLL
  - 3312 PURCHASES - RENT
  - 3313 SUPPLIES
  - 3314 REPAIRS
  - 3315 HEAT
- 3320 PREPAID AND ACCRUED CHARGES
  - 3321 DEPRECIATION
  - 3322 INSURANCE
  - 3323 TAXES

GENERAL AND OFFICE EXP. 3400

- 3410 CURRENT CHARGES
  - 3411 PAY ROLL
    - 3411.1 EXECUTIVES
    - 3411.2 CLERICAL
    - 3411.3 GENERAL
  - 3412 PURCHASES
  - 3413 SUPPLIES
  - 3414 REPAIRS
  - 3418 GENERAL WASTE CREDITS
- 3420 PREPAID AND ACCRUED CHARGES
  - 3421 DEPRECIATION
  - 3422 INSURANCE
  - 3423 TAXES

EXHIBIT Z. CHART OF EXPENSE ACCOUNT CLASSIFICATIONS

classification. A chart of accounts for a process plant would ordinarily show the direct labor, in addition to the expenses chargeable to each department.

318. Prepaid and Accrued Charges.— A distinction is made between current charges and the so-called prepaid and accrued charges. The former class of expense charges is usually obtained from the Payroll Analysis Sheet, Purchase Journal, and supplies requisitions. Current charges are often offset by waste credits from the sale of scraps of material, such as the clippings from material in any one of the needle industries. Prepaid and accrued charges, or as they are sometimes called fixed charges, are obtained from a schedule showing the amount of depreciation, insurance, and taxes chargeable to each department periodically. The method of preparing such a schedule will be fully explained in a subsequent chapter.

319. Subsidiary Expense Ledger.— Often a large number of expense accounts are needed. If these were all to be opened in the General Ledger, it would make the drawing off of the trial balance a tedious job, and consequently it is convenient to take the expense accounts out of the General Ledger and transfer them to a subsidiary Ledger, known as the Expense Ledger. The best practice is to use a separate page for each account, and to rule columns for making the distribution of expenses according to the various sub-classifications decided upon. From the accounts in the Expense Ledger the amount of each department's expense is obtained when it is required for use in making a calculation of the overhead-expense rates. The various methods in use for calculating overhead-expense rates will be explained in detail in Chapter XXVIII.

320. Accounting Periods.— It is necessary to decide upon the length of the accounting periods, or in other words how often the cost accounts are to be closed and reports made. It is, of course, quite a common practice to use the calendar month as the length of the accounting period. If this is done it is frequently necessary to make a calculation of the amount of salaries and wages which are due, but not paid at the end of the month in order that proper charges may be made to the cost accounts to cover accrued salaries and wages for these few days. Unless this is done the salaries and wages for a few days at the end of a calendar month are likely to be omitted from the calculations because the payroll may not be entered in the books until the first week in the next month. In order to do away with the necessity for calculating the amount of salaries and wages accrued at

the end of the month, the plan is sometimes followed of making the cost periods coincide with the payroll periods.

If it is desired to make the length of the accounting periods coincide with the payroll periods, it is necessary to decide whether the periods are to be four or five weeks in length. In case the payroll is made up weekly, the logical practice is to have one five-week and two four-week periods in each quarter year. By adopting this expedient the problem of accrued wages is eliminated and every quarter the cost records will exactly coincide with the financial records. This is, of course, an advantage when a quarterly financial statement is prepared for dividend or other purposes. The arrangement of the accounting periods is then as follows:

January	4 weeks	
February	4 weeks	
March	5 weeks	
First Quarter		13 weeks
April	4 weeks	
May	4 weeks	
June	5 weeks	
Second Quarter		13 weeks
July	4 weeks	
August	4 weeks	
September	5 weeks	
Third Quarter		13 weeks
October	4 weeks	
November	4 weeks	
December	5 weeks	
Fourth Quarter		13 weeks
Year		52 weeks

It will be seen readily that the method of adjusting the accounting periods, as above outlined, makes it an easy matter to include either the non-productive or productive labor for four or five weeks in the cost accounts for corresponding periods. There are thus no salary or wage accruals to calculate at the time of closing the books.

The length of the accounting period has a direct bearing upon the amounts to be included in the Overhead Expense account each period

for fixed charges such as depreciation, insurance, and taxes. The amount of each of these items is usually ascertained in advance of the current year so that the amount to be charged to any one period depends upon the relation which the length of the period bears to a year. Thus, if the equipment in Department A of a factory is valued at $26,000 and the depreciation on it is estimated at 10 per cent a year making $2,600 per annum, the amount to be included in a four-week period would be one-thirteenth of the total or $200, whereas in a five-week period the allowance would be $250. If the factory was run on four- and five-week periods, there would be $650 for depreciation in the Overhead Expense account of Department A each quarter. The same line of reasoning applies in the case of other fixed charges such as insurance and taxes, which have to be prorated in accordance with the length of the accounting period decided upon. Reference to the report of the cost committee of the Refractories Manufacturers' Association shows that the cost-accounting forms are designed for handling overhead expense on a four- and five-week period basis.

321. Basis of Expense Accounting.— The introduction of a cost system requires consideration of the proper basis to be adopted for handling the charges to the expense accounts. A fundamental requirement of all cost-accounting work obviously is that each period shall receive all of the charges belonging to it, but no others. Furthermore, at the outset each establishment must decide just which purchases can be charged directly to overhead expense when vendors' invoices are entered on the Voucher Record, or Purchase Journal, and which have to be charged to some other of the accounts on the General Ledger. The usual practice is to charge constantly recurring items such as telephone service, rent, and so on to Overhead Expense *when the expenditure is made.* Supplies and minor items of equipment which are purchased in quantities and carried in stock are properly chargeable to Overhead Expense only *when reported issued from stores.* It is perfectly obvious that if a year's supply of fuel is purchased at one time some means must be provided for *spreading its cost over the periods during which it is consumed.* The same argument holds in regard to tools and equipment, the life of which has to govern the distribution of the original cost against the Overhead Expense accounts. If, for example, a new automobile truck is pur-

chased and charged to the expense of the period when received, it is apparent that the expense of that period will appear disproportionately high on the one hand, while on the other, to omit the truck altogether is obviously contrary to the principle that no items of expense should be omitted from the overhead cost of the business. The problem of distributing the amount of the capital outlay which expires each period through depreciation rates will be considered in detail in a subsequent chapter. It is also necessary to make a charge each period to Overhead Expense to cover such items as insurance and taxes. The amount of the charge is obtained by apportioning the amount paid for insurance premiums or taxes over the various periods covered by the payment. The procedure followed in handling either deferred charges or accrued liabilities, such as insurance or taxes, will be dealt with more in detail later.

322. **Unused Capacity.**— Idle machinery during slack periods of production creates a familiar problem in job-order factories. When a part of the plant is unused, the factory overhead is not absorbed under the rates which were established to meet normal conditions. The problem of what to do with the debit balance to the Overhead Expense account arising from slack production must be solved. There are various methods of solving this problem of unused capacity. If the balance in the Factory Overhead Expense account is small, little difficulty is experienced in disposing of it, but if the balance is large, the matter is somewhat complicated. When the discrepancy is slight, it is argued that the function of the sales staff is to sell the output of the factory, and if this is not done the fault does not rest with the manufacturing department, and therefore such unabsorbed factory overhead expense is oftentimes deemed a proper charge to Profit and Loss, unless some other adjustment is made. However, if the balance to the Factory Overhead Expense account is any considerable amount, this line of reasoning is palpably crude. In such cases, the most generally accepted line of reasoning is as follows: During the period a part of the product to which the factory overhead expense has been applied has been shipped, part is in the finished-goods stockroom, and part is still in process of manufacture. Concretely assume that the overhead expense was $15,000 for the period and that $12,000 only had been spent on the product, of which amount one-third was on goods shipped, one-third on goods finished, and one-third on goods in process. On the ground that the burden rates used for the preceding period had been too low and that if they had been properly adjusted to meet the factory conditions the balance of $3,000 would all have been distributed, it is reasonable to assume that $1,000 should be charged to cost of sales, $1,000 to finished goods, and $1,000 to work in process. This, it will readily be seen, gives a different result in the Balance Sheet and the Profit and Loss statement than would be obtained by charging the entire balance of $3,000 to the cost of sales for the period. It is a well recognized principle of cost accounting that the balance to the Overhead Expense account must be properly distributed before the books are closed at the end of an accounting period. The degree of refinement required in making the proper distribution of the balance to the Overhead Expense account depends upon local conditions. If goods are made under a contract which calls for payment on the basis of cost plus a fixed percentage, it is obvious that extreme care should be exercised in distributing the Overhead Expense remaining unabsorbed because of the idleness of the plant during periods of slack production. If a relatively large amount of undistributed Factory Overhead remains at the close of an accounting period, the inventory should be re-figured so that a correct Balance Sheet and Profit and Loss account may be prepared.

323. **Accounting Control.**— It is a well recognized principle of cost accounting that every element of Overhead Expense should be included in the controlling Ledger accounts. There is sometimes a temptation to omit some items but this should never be permitted. It should always be possible to arrive at the total Overhead Expense for any period by referring to the proper ledger accounts. In case the plant is large there should be operated a subsidiary Expense Ledger giving in detail the charges to each expense-account classification. The purpose of the operation of the Expense Ledger is to provide a convenient means for preparing a detailed statement of Overhead Expense at the end of each accounting period. There have been many cases in which the compilation of expense statements has been done independently of Ledger control with the result that it is difficult to repose confidence in them. The possibility that the figures may be more or less erroneous is always present. The preparation of a detailed statement of expense, the totals of which can be

reconciled with the controlling Expense account, furnishes a means of proving the accuracy of figures not otherwise obtainable. In this way confidence can be established in the figures submitted. Since the detailed statement of Overhead Expense furnishes a valuable administrative record, it is of the utmost importance that it be accurately prepared and capable of verification. One or more controlling Expense accounts can be operated if it is deemed advisable. Thus, it is often found advantageous to have one such account for the Factory Overhead, one for Selling Overhead, and one for Administrative Overhead. However, care should be exercised to see that the Ledger is not encumbered with more controlling accounts than necessary.

324. **Summary of Principles.**— In order to obtain the desired result from a cost-finding system it is necessary that the accounting periods end at the same time that payroll periods do or that accrued salaries and wages be set up; that all supplies and services purchased be charged to the period when consumed or when service is rendered; that information be obtained from original sources; that the cost of inside service be separately ascertained and transfers made to the various operating departments according to the quantity and cost of service rendered each; that Overhead Expense be applied to the product in a way to obtain the exact cost to make and sell; that the cost of unused capacity be properly distributed; and that all Overhead Expense accounts be under complete Ledger control.

Questions on Chapter XXIII

1. How often should the books in a factory be closed?
2. What is the best method to follow in adjusting the accounting periods so that one does not have to split the payroll at the end of a period?
3. What effect does the length of an accounting period have on the amount of fixed charges to be charged to the Expense account?
4. What purchases should be charged directly to Expense? Give an example of an item which is properly chargeable to Expense when the bill is received and of one which cannot be charged to Expense until a subsequent period.
5. From what source is information obtained pertaining to the non-productive or indirect labor chargeable to expense?
6. What is meant by the cost of inside service? Give an example.
7. What is meant by unused capacity? Give an example.
8. What method is generally followed for controlling Expense?

CHAPTER XXIV

CURRENT CHARGES TO OVERHEAD EXPENSE

325. **Analysis of Expense.**— It is necessary to provide a routine for analyzing the payroll, purchases, supplies, requisitions, and various miscellaneous items in the total current charges to Overhead Expense and for segregating all current charges to the expense accounts of the various departments. The complete departmentalization of expenses so peculiarly a characteristic of a cost-accounting system, facilitates a calculation of total unit cost for each process in a process factory and the establishment of appropriate overhead rates for the departments of a job-order establishment.

326. **Indirect Labor.**— The first step in carrying out the analysis is the distribution of the weekly payrolls between direct and indirect labor. The wages of operatives who work on processes or on orders appear under the direct-labor classification as shown in Form 86. Employees who perform the work of supervision; bookkeepers, clerks, inspectors, cleaners, firemen, or any others rendering services of a general character come under the indirect-labor classification. For cost work the salary of a sole proprietor should be charged up to Expense and his drawing account credited. It is necessary to study the organization of each plant as explained in Chapter XVIII in order to determine how the payroll should be analyzed. The timekeeping system should provide for dividing the wages of operatives whose time is partly direct and partly indirect. Thus, if a pressman in a job-printing establishment stops work on orders for an hour while waiting for copy, his idle time should be charged to the Expense account of the department where he works. In order to provide an easy method for classifying the indirect labor of factory operatives it is customary to provide the shop with a series of *Standing Orders,* usually referred to as the "S. O. Numbers." Referring to the "Chart of Expense Account Classifications," shown in Exhibit Z, and listing the indirect-labor items, the following code is obtained:

INDIRECT-LABOR CODE

Manufacturing Expense:	
Dept. A	1111
Dept. B	1211
Dept. C	1311
Dept. D	1411
Dept. E	1511
Selling Expense	2011
Miscellaneous:	
Repairs	3111
Power	3211
Building and Occupancy	3311
General and Office	3411

Shop operatives doing work chargeable to expense should indicate the account to which their wages are to be charged by writing the proper S. O. number on their time tickets. In case a mechanic in Department A stopped to make a repair to his press he would charge his time to S. O. 1111. It is, of course, unnecessary to require time tickets from employees who are permanently in the indirect labor class. This class includes the administrative officers, clerks, bookkeepers, porters, elevator men, and others employed in occupations which are always indirect. Bonuses paid for overtime work or for punctuality are chargeable to Overhead Expense even if the person who performed the service is engaged in work directly associated with a particular product or process. Bonuses are made to promote general efficiency, and they usually reduce the necessity of general expenditures for added supervision and for replacement of defective products. At the end of each payroll period all indirect labor charges have to be recapitulated and entered on the Payroll Analysis Sheet (Form 86).

327. **Purchases Chargeable Directly to Expense.**— In every business there are constantly recurring items of expense which are entered in the "Purchase Journal," Form 35, every month. Instances of purchases chargeable directly to Expense are the monthly bills for telephone, telegraph and messenger service, light and power service, drinking water, towel service, and so on. Then, too, there are petty-cash disbursements, for postage, stationery, and office supplies. It is customary to charge any item of expenditure to the month when the vendor's invoice is received, provided that the item

covered by the invoice properly belongs to the cost of doing business that month. If, however, it is impracticable to allocate a purchase to the exact period to which its cost belongs, as in the case of bills for minor repairs to equipment or buildings, it is the practice to charge such items to Expense when the bills are received. Under each departmental classification shown in the Chart of Expense Account Classifications (Exhibit Z) provision is made for entering purchased items. If there are only a few departments the distribution of purchases chargeable to expense can be made on the Purchase Journal and posted from there at the end of the month directly to the proper expense accounts in the General Ledger. However, if there are many departments it is the practice to remove the detailed expense accounts from the General Ledger and keep them in the auxiliary Expense Ledger. When this is done, invoices are marked with the proper code numbers in accordance with the Chart of Expense Account Classifications and not only are entered in the "Expense" column of the Purchase Journal but are also posted to the proper accounts in the Expense Ledger. At the end of an accounting period the total of all expense purchases entered on the auxiliary or subsidiary Expense Ledger should agree with the total charged to the Expense account in the main Ledger through the medium of the Purchase Journal. The Expense Ledger usually consists of columnar sheets, one of which is used for each departmental classification shown in the Chart of Expense Account Classifications. The columns on the department expense sheets are headed with the sub-Expense-account classifications, one of these classifications usually being "Purchases."

328. **Supplies Issues Chargeable to Expense.**— If supplies such as emery paper, oils, chemicals, tacks, stationery, and so on are purchased in considerable quantities and put in stock to be subsequently issued to departments, it is the practice to charge the supplies when purchased to a supplies inventory account on the General Ledger. Then when supplies are issued to departments on requisitions it is the custom to credit the Supplies account and charge the proper departmental accounts according to the code number, marked on the various requisitions, which code numbers are obtained from the Chart of Expense Account Classifications. After supplies have been issued the proper procedure is to send requisitions to the stock-

record clerk who makes the entry on the issued side of the Stores Ledger and fills in the price and amount columns on the requisitions. Then the requisitions should be posted directly to the Expense Ledger, according to the department called for by the code, and in the column on the Ledger sheets marked "Supplies." At the end of the month the total supplies requisitions entered in the Expense Ledger should be summarized and an entry made crediting the Supplies account in the General Ledger and charging the proper controlling accounts. Proof of the accuracy of the information obtained from the supplies requisitions is made at inventory time. Then balances appearing on the Supplies Ledger cards are compared with the actual count which is made of the supplies on hand. The total amount of the inventory of supplies should also agree with the balance to the supplies inventory account in the General Ledger.

329. **Production Charged to Expense.**— Whenever a job which has been made in the factory, and figured at cost, is classified as being a charge to expense it is necessary to post it on the Expense Ledger. When an inspector, for example, rejects a piece of work as defective and takes the job out of process, it is necessary to figure the cost incurred up to that point, deduct the scrap value of the material and charge the difference to the proper expense code in accordance with the Chart of Expense Account Classifications (Exhibit Z). The loss due to defective work is not regarded as a charge against any particular job but rather as a burden to be imposed on the department in which the mistake took place.

This principle is especially applicable to costs in the metallurgical industries of the process type. In iron, steel, and non-ferrous metal foundries, defective castings occur frequently. Good castings must bear the total cost of production, including the expense of making bad castings. The procedure is simply to divide the total cost of production (less the scrap value of bad castings), by the good castings, on a given job or class of work.

In the brick-making industry, many of the bricks produced are defective but can, nevertheless, be ground up and used in the mixture of material of new bricks. The procedure followed is to charge the cost of production to the Broken Bricks account. Broken bricks can be sold in the market because of their value as grindable material. The Broken Bricks account is credited with this scrap value

and the balance prorated over the salable bricks. This is the plan followed in all of the clay-products industries.

In many industries a part of the product is of inferior grade and has to be sold as seconds at a price usually less than cost. This entails a loss which, of course, has to be assessed against the firsts. One method is to open an account to which the cost of producing seconds is charged. The account is then credited for the return from the sales of seconds. After the transaction has been completed the balance remaining, if there is a loss on seconds, is a charge to Overhead Expense. Thus, in a hosiery mill it is necessary to issue an order to make a greater quantity of hosiery than is required because there is always a portion of the product which has to be sold as seconds. The loss on these must be spread as a burden over the cost of first grade products. This is also the general plan of procedure in other branches of the knit-goods industry.

330. **Miscellaneous Charges and Credits to Expense.**— It is likely that there will be miscellaneous entries to the Factory Expense account such as charges covering a part of the general administration expense, or credits from the sale of waste. Waste which results from factory operations, and which cannot be applied directly as an offset to the cost of raw material used in making the product, should be credited to Overhead Expense. If waste is sold to outside customers, no difficulty is experienced in ascertaining the amount to be credited to the Expense account. In a collar and cuff and shirt factory cuttings from linen cloth are sold as rag stock to paper manufacturers; the cuttings sold are a credit to Expense, thereby reducing the burden to be applied to the product. Gold and silver reclaimed from the sweepings in a jewelry factory are a credit to the Factory Expense account. Sometimes waste products are used in the factory instead of being sold outside. A ton of cocoanut shells is worth as much for heat-producing purposes as a ton of coal and so in a factory manufacturing prepared cocoanut the shells are credited to the department where the cocoanuts are used and a charge made to General Power Expense.

331. **Summary.**— It is necessary to treat all current overhead expenditures belonging to the period when made as a direct charge to Overhead Expense. This requires that payrolls, purchases, supplies requisitions, and other sources of cost data be carefully ana-

lyzed. In order to expedite the work of analysis a Chart of Expense Account Classification should be followed as a guide in distributing current charges to various classes of Overhead Expense.

Questions on Chapter XXIV

1. From what sources does most of the information pertaining to Overhead Expense come?
2. What routine is followed for obtaining a record of the indirect labor chargeable to Overhead Expense?
3. What is meant by a code of S. O. Numbers? Explain how one operates.
4. In what way are purchases charged directly to the Expense of various departments?
5. How can the accuracy of the work of recording purchases chargeable to Expense be verified?
6. How can supplies chargeable to Expense be controlled, and the accuracy of the work of recording proved?
7. How should defective work be recorded? Illustrate.
8. What disposition should be made of revenue from sales of waste? Illustrate.

CHAPTER XXV

PREPAID AND ACCRUED CHARGES TO OVERHEAD EXPENSE

332. Fixed Charges.— The Expense account of each period must include a prorata allowance to cover items which have been prepaid on the one hand or which have accrued but have not yet been paid, on the other. If this allowance is not included it is likely that the expenses for any particular period will be either over- or understated. Premiums on insurance policies are paid in advance and so it is necessary to prorate the premium over the period covered by the policy. Likewise taxes, if prepaid, are handled like insurance premiums. However, it usually happens that during a part of the year, pending the receipt of the tax bill, the taxes accrue. Provision must also be made each period for the depreciation on the plant. It is quite common to hear insurance and taxes referred to as fixed charges because they are fixed by people and according to principles aside from the business itself and they do not vary from period to period with the increase or decrease in production. Depreciation, with less scientific justification, but for convenience, is also classed as a fixed charge.

333. Expired Capital Outlay.— When a plant is acquired, a considerable capital outlay is usually made. A complete plant requires land, buildings, machinery, tools, fixtures, and furniture. Each part of the plant has a certain life. Buildings last longer, of course, than tools, but as time passes parts of the plant wear out or become obsolete, and at the end of each period a part of the life of the plant has expired. This necessitates that the "expired capital outlay" for the period be written off as a depreciation charge. In order to make the calculation of this amount of the depreciation charge to Overhead Expense each period it is necessary to have a detailed record of the cost of the plant, and an estimate of the probable life of each part, together with their estimated scrap values at the expiration of the life of the plant. If the record of the cost of the plant is not available, it is necessary that an appraisal be made.

334. Plant Ledger.— The record of the cost of the various parts of the plant, or the appraisal, furnishes the information required for opening the Plant Ledger. No special form is required for this ledger, either a loose-leaf or card-index system being adaptable to the needs of the case. Provision must be made for making a current record of all additions to the plant when new parts are purchased or manufactured in the shop. Information regarding purchases is, of course, obtained from vendors' invoices which are charged to plant accounts. When additions are made in the shop such as jigs, tools, patterns, flasks, and various other articles of equipment, the cost of manufacture is obtained from the Cost Sheets made out by the cost department after the jobs are completed. Deductions from equipment must also be entered on the Plant Ledger so that it will show the cost of the plant at all times. Deductions cover all parts of the plant removed whether sold or scrapped. The principal point to bear in mind in this connection is that the credit entries are made at cost. By this means the sum of the balances to the plant accounts represents the cost of the plant. When a physical inventory of the plant is taken it should be checked in detail with the records kept in the Plant Ledger to insure against discrepancies either in the book records of material and stock on hand or in the physical inventory.

MACHINERY RECORD

No. _____ Name of Machine _____
Made by _____ Size _____
Bought of _____ Order No. _____
Invoice No. _____ Date of Invoice _____
Description _____

Date	Location			Remarks	Cost	
	Sec.	Floor	Dep't.			
					Machine	
					Freight	
					Installation	
					Total	

Form 90. MACHINERY RECORD

335. Machinery Record.— It is not practicable to present a single general form for use in recording all classes of equipment. However, the form used for keeping a record of machinery will suggest the method of procedure followed in designing Plant Ledger cards. A card suitable for the purpose of keeping a record of machinery is shown in Form 90. The upper portion provides for writing in a complete description of the machine. In the lower part of the form the location and cost of the machine are entered. These record cards are usually filed according to location so that the value of the machinery in a particular department can be readily ascertained as a basis for making an apportionment of fixed charges. A cross-index arranged by name of machine should be operated in connection with the Machinery Record. Then any machine can be found if either its location or name are known. Record cards of a similar kind can be made for recording furniture, fixtures, patterns, flasks, and tools.

336. Plant Records.— In setting up plant accounts it is practicable only to make certain subdivisions of them on the General Ledger, keeping the detail accounts on the Plant Ledger which is run as a subsidiary Ledger to the controlling plant accounts. The logical method of procedure in setting up plant accounts is to arrange them in the order in which property is usually acquired. Thus, if a plant is owned we would begin with the land, then take the building, light, heat and power plant, machine tools, furniture and fixtures, patterns, flasks, small tools, and so on through the list. Under each classification we would indicate a number of subdivisions depending upon the nature of the group. Thus, under power, we would follow out the same plan and have first the steam-generating system, then the electric-current generating and transmission system, then the compressed-air system, and so on. In a larger plant there are numerous sub-classifications to be provided for. It will be seen readily that the proper setting up of the plant accounts has a definite bearing on the making of charges to the expense accounts. Thus, the maintenance and upkeep of the grounds and buildings is a part of the Expense of Occupancy, while the fixed charges on the steam-generating system are a charge against the Cost of Power and so on. It is safe to say that no satisfactory system of expense accounts can be put into operation unless there is a complete inventory and classification of plant items. We will next consider some of the factors

which must be taken into account when calculating the amount of the plant outlay which expires each period.

337. **Depreciation.**— A properly kept Plant Ledger gives the valuation of all equipment at *cost price* and all future valuations should be based on this cost and not upon varying market valuations of similar articles, at later dates. A record must be made of the amount which the plant diminishes in value due to the "expired capital outlay" for the period. The record of the amount of expired capital outlay and depreciated value of the plant should be kept in an auxiliary Ledger of either loose-leaf or card-index form. The principal point to be kept in mind is that an exact record of the amount of depreciation written off for each part of the plant should be at all times available. In setting up a Balance Sheet it is necessary to show the amount of depreciation on each class of plant equipment as a deduction from the original cost. The net balance, of course, represents the depreciated value of the plant. Supplementary statements should be prepared from time to time showing the percentage of the original cost of each part of the plant remaining.

Wear and Tear.— In every plant the buildings, machinery, and all equipment are subject to deterioration from ordinary wear and tear. From time to time various parts of the plant and equipment reach such a condition that it is deemed no longer profitable to keep them in good operating condition by means of repairs and so a replacement is decided upon. Thus, as time goes on, boiler tubes have to be replaced due to rust and the effects of boiler scale; and finally a complete new boiler installation is required. The same thing happens to other items of equipment, the only difference being that the life varies in each case.

Repairs.— The life of the plant and equipment depends to a certain extent upon the attention given to repairs. Repairs constitute a remedial measure, such as the painting of wood and iron in order to prevent decay and rust. This tends to preserve the material from deterioration and, therefore, is a repair charge. The replacement of a broken window pane or a belt is also considered a repair. If repair expenditures are made liberally, it is evident that the life of the plant and equipment will be prolonged. Ordinarily repairs are a constantly recurring charge and are not extraordinarily high or low in any period as compared with any other period.

Obsolescence.— Another factor which frequently affects the life of the plant or equipment is obsolescence, for as time goes on it is likely that parts or even the whole plant will not be adapted to meet changed conditions. The frame building of a decade ago does not meet the present day needs of a manufacturing establishment as well as a reënforced concrete building. The probability that a part or all of the plant will need to be replaced before being worn out is always a contingency which must be anticipated. In some industries, of course, obsolescence is much more a factor than in others.

Replacements.— When a part of the plant wears out or becomes obsolete it is necessary to replace it. To charge it to the period when replacement is made as though it were a relatively minor repair would result in an abnormal expense for the period. In anticipation of the need of replacing the various parts of the plant and equipment ultimately it is the practice to set aside a reserve to cover depreciation each period. The amount set aside in the reserve fund is charged to Expense. By this means a sufficient balance is accumulated in the reserve so that when the replacement is made the original cost can be charged against the reserve. The old item of plant or equipment is taken out of the Plant account and a notation of the fact made on the Plant Ledger. New plant and equipment items for replacement are entered on the Plant Record and charged to plant accounts the same as any new plant items purchased.

Abnormal Depreciation.— It happens sometimes that a new invention renders much valuable equipment obsolete. The operation of the new machinery, made possible by this invention, may be so much more economical than that of operating the old machinery that it is no longer desirable to keep the old equipment in use. When this occurs it is necessary to charge the excessive depreciation due to *premature obsolescence* to profit and loss. Sometimes equipment is suddenly made worthless by an accident, and in such a circumstance the loss due to the accident is a proper charge to Profit and Loss. When insurance covers the matter, there is, of course, no loss.

Scrap Value.— Inasmuch as certain parts of the plant and equipment have a scrap value this has to be considered when figuring on the amount of the capital outlay for plant and equipment which expires each period. Care must be taken that the allowance for the value of scrap is not excessive, otherwise it is likely that the expense

of converting it into a salable commodity may partially or wholly offset its sale. The amount of scrap value figured upon is that which one would ordinarily expect the plant or equipment to retain when it is no longer of service. However, under abnormal conditions the scrap value may be more than that originally estimated, in which case an adjustment has to be made to the Plant account. The contra entry is to Profit and Loss.

338. **Methods of Calculating Depreciation:** *Fixed-Proportion Method* (Exhibit AA).— There are several methods in vogue for

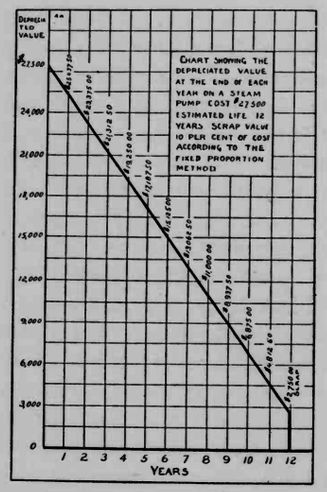


EXHIBIT AA. CHART SHOWING THE DEPRECIATED VALUE AT THE END OF EACH YEAR OF A STEAM PUMP, ACCORDING TO THE FIXED PROPORTION METHOD

calculating depreciation. These methods are known as the fixed-proportion method; the fixed percentage on diminishing value method; and the sinking-fund method. We will consider each separately.

The fixed-proportion method of calculating the amount of depreciation on the plant consists in dividing the original cost less the estimated scrap value by the estimated life. The calculation of the amount of depreciation is thus seen to be an easy matter, which ac-

counts for the fact that this method of writing off a fixed proportion of the plant each year is the most common of the methods in use for handling depreciation. Reference to the following example will make the method of calculation clear. This example shows the depreciation record for a steam pump, costing $27,500, with an estimated life of 12 years, and scrap value equal to 10 per cent of the cost. Each year a fixed proportion of the original cost, less the scrap value, is written off, leaving the depreciated value. At the

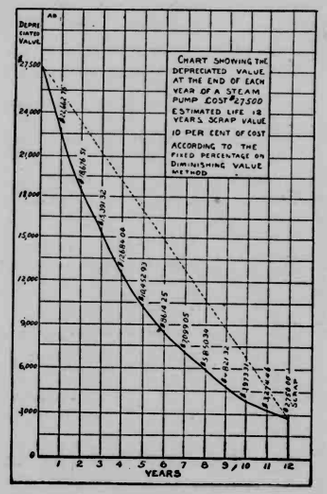


EXHIBIT AB. CHART SHOWING THE DEPRECIATED VALUE AT THE END OF EACH YEAR ACCORDING TO THE FIXED PERCENTAGE ON DIMINISHING VALUE METHOD

end of the life of the pump the scrap value is reached as shown on page 298.

A chart has been prepared as shown in Exhibit AA giving the depreciated value at the end of each year of the life of the steam pump. It will be noticed that the line showing the value of the plant retained at the end of each year is straight, on which account this method is frequently referred to as the "straight-line method."

339. *Fixed Percentage on Diminishing Value Method* (Exhibit AB).— Repairs on a plant tend to increase as time goes on until the

DEPRECIATION RECORD OF STEAM PUMP

Cost, $27,500.00. Estimated life, 12 Years. Estimated scrap value, 10 per cent of cost.

Initial cost	$27,500.00
1st year depreciation	2,062.50
	25,437.50
2nd year depreciation	2,062.50
	23,375.00
3rd year depreciation	2,062.50
	21,312.50
4th year depreciation	2,062.50
	19,250.00
5th year depreciation	2,062.50
	17,187.50
6th year depreciation	2,062.50
	15,125.00
7th year depreciation	2,062.50
	13,062.50
8th year depreciation	2,062.50
	11,000.00
9th year depreciation	2,062.50
	8,937.50
10th year depreciation	2,062.50
	6,875.00
11th year depreciation	2,062.50
	4,812.50
12th year depreciation	2,062.50
Scrap value	$ 2,750.00

repairs become so great that it is no longer economical to operate the plant. If a fixed proportion is written off each year to cover depreciation it is evident that the charges to Overhead Expense for depreciation and repairs will increase as time goes on. Because of this, the plan of writing off a fixed percentage on diminishing value

is sometimes used. This plan, as its name indicates, consists in writing off a fixed percentage of the residual balance each year. By following this plan the amount of depreciation written off is greatest when the plant is new and gradually diminishes until the scrap value is reached. It follows, therefore, that as the repairs increase the depreciation charge decreases. By this means the annual charge to Overhead Expense is kept more constant and this is deemed an advantage. From a purely theoretical point of view the fixed percentage on diminishing value method is the more scientific for the reasons above given. The practical objection raised against the method is that it is not as easy to calculate the depreciation as it is in the case of the other methods.

The formula used in the fixed percentage of diminishing value method for calculating depreciation is derived as follows:

The fixed percentage must be determined so that the *original value* V will be reduced to the *residual value* R in n periods. If r be the fixed annual *rate of diminution,* then

$V(1-r)$ is the reduced value at the end of the first period,
$V(1-r)^2$ is the reduced value at the end of the second period,
$V(1-r)^n$ is the reduced value at the end of n periods, at which time the residual value R is reached.

Therefore, $V(1-r)^n = R$

Solving for r, we have the following:

$$(1-r)^n = \frac{R}{V}$$

$$1-r = \sqrt[n]{\frac{R}{V}}$$

$$r = 1 - \sqrt[n]{\frac{R}{V}}$$

Let us now calculate the rate to use for writing off depreciation on a steam pump where the constants are as follows:

$n = 12$ years of life
$V = \$27{,}500.00$, cost
$R = \$\ 2{,}750.00$, scrap value

$$\text{then } r = 1 - \sqrt[12]{\frac{\$2{,}750.00}{\$27{,}500.00}}$$

$$r = 1 - \frac{\text{Log } \overline{12} + 11.000}{12}$$

$$= 1 - \text{Log } \overline{1}.916666$$

$$1 - .825404$$

$$= .174596, \text{ or } 17.4596 \text{ per cent.}$$

DEPRECIATION RECORD OF STEAM PUMP

Initial cost		$27,500.00
1st year depreciation	17.4596 per cent of $27,500.00	4,801.39
		22,698.61
2nd year depreciation	17.4596 per cent of $22,698.61	3,963.08
		18,735.53
3rd year depreciation	17.4596 per cent of $18,735.53	3,271.14
		15,464.39
4th year depreciation	17.4596 per cent of $15,464.39	2,700.02
		12,764.37
5th year depreciation	17.4596 per cent of $12,764.37	2,228.61
		10,535.76
6th year depreciation	17.4596 per cent of $10,535.76	1,839.51
		8,696.25
7th year depreciation	17.4596 per cent of $ 8,696.25	1,518.33
		7,177.92
8th year depreciation	17.4596 per cent of $ 7,177.92	1,253.24
		5,924.68
9th year depreciation	17.4596 per cent of $ 5,924.68	1,034.42
		4,890.26
10th year depreciation	17.4596 per cent of $ 4,890.26	853.82
		4,036.44
11th year depreciation	17.4596 per cent of $ 4,036.44	704.75
		3,331.69
12th year depreciation	17.4596 per cent of $ 3,331.69	581.69
Scrap value		$ 2,750.00

In Exhibit AB it will be noticed that the line sags considerably below the position which the line showing depreciated values took in

the first chart (Exhibit AA). This is due to the fact that the amounts written off to cover depreciation when the plant is new are largest, as shown by the table.

340. *Sinking-Fund Method.*— In case it is desired to establish a sinking fund to use for replacing parts of the plant when worn out, a different method is used (Exhibit AC). The assets in the fund draw interest, and so in making a calculation of the amount which must be contributed to the fund each year the interest accumulations must be considered. Even if a fund is not actually established the

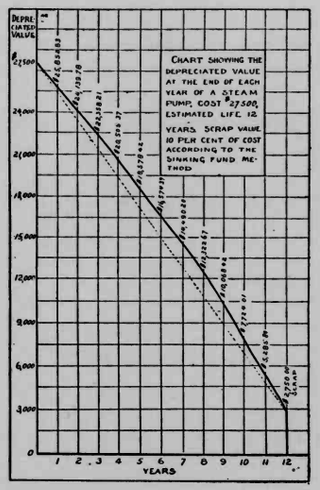


EXHIBIT AC. CHART SHOWING THE DEPRECIATED VALUE AT THE END OF EACH YEAR ACCORDING TO THE SINKING FUND METHOD

sinking-fund method of calculation is sometimes used because by its use annual additions to the fund, consisting of the contribution and the interest accumulations, tend to increase and this has the effect of reducing the depreciated value slowly at first and then at a gradually increasing rate. Advocates of this method argue that the depreciated values thus obtained coincide more closely with actual practice than the values obtained by the use of either of the two foregoing methods.

Depreciation Record of Steam Pump

Initial cost		$27,500.00
1st year contribution	$1,647.17	1,647.17
		25,852.83
2nd year 4 per cent interest on $1,647.17	65.88	
2nd year contribution	1,647.17	1,713.05
		24,139.78
3rd year 4 per cent interest on $3,360.22	134.40	
3rd year contribution	1,647.17	1,781.57
		22,358.21
4th year 4 per cent interest on $5,141.79	205.67	
4th year contribution	1,647.17	1,852.84
		20,505.37
5th year 4 per cent interest on $6,994.63	279.78	
5th year contribution	1,647.17	1,926.95
		18,578.42
6th year 4 per cent interest on $8,921.58	356.86	
6th year contribution	1,647.17	2,004.03
		16,574.39
7th year 4 per cent interest on $10,925.61	437.02	
7th year contribution	1,647.17	2,084.19
		14,490.20
8th year 4 per cent interest on $13,009.80	520.36	
8th year contribution	1,647.17	2,167.53
		12,322.67
9th year 4 per cent interest on $15,177.33	607.08	
9th year contribution	1,647.17	2,254.25
		10,068.42
10th year 4 per cent interest on $17,431.58	697.24	
10th year contribution	1,647.17	2,344.41
		7,724.01
11th year 4 per cent interest on $19,775.99	791.04	
11th year contribution	1,647.17	2,438.21
		5,285.80
12th year 4 per cent interest on $22,214.20	888.63	
12th year contribution	1,647.17	2,535.80
Scrap value		$ 2,750.00

The rate is easily calculated. If an annuity table is at hand one needs only to consult it to ascertain the amount of an annuity, at any desired rate of interest, which must be invested annually during the life of the plant to amount to $1. This figure can then be multiplied into the cost less the scrap value to obtain the sinking-fund contribution. If a table is not at hand, the method of calculating the contribution is as follows:

Suppose that the fund is expected to earn four per cent and that the life of the plant is 12 years. One dollar contributed yearly for 12 years to a fund, which earns four per cent compound interest, will produce $15.025,805,46. Divide this figure into one dollar and $0.066,552,17 will be obtained which is the amount of the annuity required. Now multiply the cost of the plant, $27,500 less the scrap value of $2,750.00, or $24,750.00 by $0.066,552,17 and $1,647.17 is obtained, which is the amount of the annual contribution which must be made to the fund. The depreciation record on the preceding page shows how the plan works out.

Exhibit AC has been prepared from the data contained in the foregoing table in order to show graphically how the depreciated values correspond with those obtained by the use of the first two methods. It will be noticed that the curve tends to rise slightly above the direction it would take if drawn straight. This is due to the effect which the interest accumulations have on the result.

In order to compare the results obtained from the use of the three foregoing methods for calculating depreciation the table on the following page has been prepared showing the percentage of the original cost remaining at the end of each year.

From the following table it will be noticed, for example, that at the end of the sixth year the percentage of the original cost remaining is 55 under the fixed-proportion method, 31 under the fixed percentage on diminishing value method, and 60 under the sinking-fund method. However, at the end of the twelfth year 10 per cent of the original value is reached in each case. Because of its simplicity the first method is the one most generally used.

The Chart of Account Classifications must always provide a place for charging depreciation. Ordinarily depreciation on office furniture and fixtures is a charge to Administration Expense, while the depreciation on the machinery and equipment in a manufacturing

TABLE SHOWING PERCENTAGE OF ORIGINAL COST REMAINING AT THE END OF EACH YEAR ACCORDING TO EACH OF THREE METHODS FOR CALCULATING DEPRECIATION OF STEAM PUMP. COST, $27,500.00; ESTIMATED LIFE, 12 YEARS; ESTIMATED SCRAP VALUE, 10 PER CENT OF COST.

	Fixed-Proportion Method		Fixed Percentage on Diminishing Value Method		Sinking-Fund Method	
	Amount	Per Cent	Amount	Per Cent	Amount	Per Cent
Initial cost....	$27,500.00	100	$27,500.00	100	$27,500.00	100
1st year.....	25,437.50	92	22,698.61	82	25,852.83	94
2nd "	23,375.00	85	18,735.53	68	24,139.78	87
3rd "	21,312.50	77	15,464.39	56	22,358.21	81
4th "	19,250.00	70	12,764.37	46	20,505.37	75
5th "	17,187.50	62	10,535.76	38	18,578.42	68
6th "	15,125.00	55	8,696.25	31	16,574.39	60
7th "	13,062.50	47	7,177.92	26	14,490.20	53
8th "	11,000.00	40	5,924.68	21	12,322.67	45
9th "	8,937.50	32	4,890.26	17	10,068.42	36
10th "	6,875.00	25	4,036.44	14	7,724.01	28
11th "	4,812.50	17	3,331.69	12	5,285.80	19
12th "	2,750.00	10	2,750.00	10	2,750.00	10

department is a charge to the Overhead Expense account of that department. Depreciation on the building is a charge to Building Expense; that on the power plant to Power Expense, and so on. It is thus seen that in order to make the proper distribution of depreciation a complete record of plant values is necessary.

341. **Depletion.**— It is quite usual to refer to the exhaustion which takes place on natural resources when raw materials are extracted from mines, quarries, clay beds, gravel banks, or timber is cut from forest lands, as *depletion*. Extractive industries are usually of the continuous-process type and consequently a charge to cover depletion of the natural resource is made directly to the process in which the raw material is used. One method of calculation is illustrated in the case of iron-ore deposits. The method is to estimate the amount of the ore reserve and to apportion the cost of the mining property over the estimated tonnage in the reserve. Another method is to attach an arbitrary figure to the raw material extracted as in the case of spruce logs used for making wood pulp in paper mills. A price per cord is determined upon for the lumber and the Forest Lands account credited for the amount of the timber cut at the price fixed. The pulp mill is, of course, charged and the depletion included with sulphite and other items when calculating the cost of production.

Attention should be directed to the fact that when dealing with assets subject to depletion (sometimes referred to as wasting assets), it is unnecessary to set aside a (cash) reserve fund for depletion because the stockholders know that the operation of the property is constantly diminishing the resources and that when all the materials have been extracted there will be no more dividends forthcoming. Of course, if the directors think it desirable they can accumulate a fund with which to purchase another piece of property in order to continue operations when the resources of the present property are entirely exhausted.

342. **Leasehold Property.**— When buildings are erected on leased land they usually revert to the landlord at the expiration of the lease. In this case it is the best practice to prorate the cost of all improvements over the period of the lease.

343. **Major Repairs.**— When the plant is new there is but little expense for repairs on the buildings and permanent fixtures. However, the day is sure to come when the roof or some other parts of the building will need extensive repairs. Because of this condition it is often advisable to treat major repairs as a fixed charge and handle repairs in much the same way that depreciation is handled. The plan is to make an estimate of the probable necessary expense a long while in advance of the time when the repairs will actually have to be made. Then a *pro rata* amount can be charged to expense each period to cover these repairs and a credit made to an account called Reserve for Repairs. Finally, when the time does come to make the foreseen repairs, the cost of making them can be charged against this Reserve account. In this way no one period has to bear a disproportionate share of the burden for major repairs. It is, of course, evident that the amount of these repairs will vary widely from period to period, and will gradually increase as time goes on. The setting aside of a reserve as suggested furnishes a good means of checking the expenditures made for repairs over a long period of time and thus acts as a sort of check on the calculation of the amount of the original estimate. The calculation of the amount set aside is generally based on a percentage of the cost of plant. Obviously a different percentage is used for each class of equipment of the plant because buildings, power plants, and permanent fixtures such as elevators, are subject to different rates for repairs.

A good example of the method of setting aside a reserve for repairs on the books of a company is found in connection with the operation of blast furnaces. These have to be relined with refractory materials at various intervals, depending upon operating conditions. The cost of relining a blast furnace is heavy and if the total cost of doing the work were to be included in the Expense account of the period when the work was done, it would cause an abnormal increase in the cost of producing pig iron during that period. Hence the practice is followed of periodically setting aside a reserve which will be sufficient to meet the cost of relining furnaces when the time comes for making repairs. Another example of the use of a reserve for repairs is found in the operation of greenhouses. It is customary to make repairs in the summer and so it is necessary to make a monthly charge of the necessary amount to Expense and credit the Reserve for Repairs account in order to apportion the annual cost of repairs properly.

344. Copyrights.— Copyrights in the United States are issued for a period of 28 years and their cost is sometimes prorated accordingly. However, a more conservative plan is to estimate the period of salability of the subject of copyright and to prorate over this period the amount to be charged off but retaining the copyright period as the upper limit.

345. Patents.— In the United States patents are issued for a term of 17 years. It is the practice of manufacturing companies to capitalize all expenses incurred in connection with obtaining patents. The cost includes experimental work, models and drawings, fees of Patent Office, legal expenses, and so on. Depreciation should be written off patents annually at the rate of one-seventeenth of their cost and charged to expense each period.

346. Trademarks and Brands.— It is not considered correct accounting practice to write off depreciation on either trademarks or brands. If a trademark is sold and a loss sustained, it is a capital charge. But, since the cost of registering trademarks and brands is nominal, it should be charged directly to the expense of doing business during the period when the expenditure is made.

347. Goodwill.— It is not the practice to depreciate goodwill because goodwill is an intangible asset that cannot suffer loss by reason of wear and tear or obsolescence. However, in periods of prosperity

the book value of goodwill as an asset is sometimes written down. If this is done, the charge is made to the Surplus account and not to Expense.

348. Insurance Record.— The customary practice of handling insurance is to prorate the premium payments over the various periods covered by the life of the policies. Premiums when paid are charged to an Insurance Prepaid account. It is necessary that a schedule be prepared showing the amount of insurance to be charged to Expense each period. If there are a number of insurance policies

91 INSURANCE RECORD

Kind Fire Pol. No. 2,375,210 Monthly Rate $12.50

Company London Globe

Property Factory and Equipment

Location New Bedford

Amount $75,000 Prem. $150

Rate $2.00 Term 1 Year

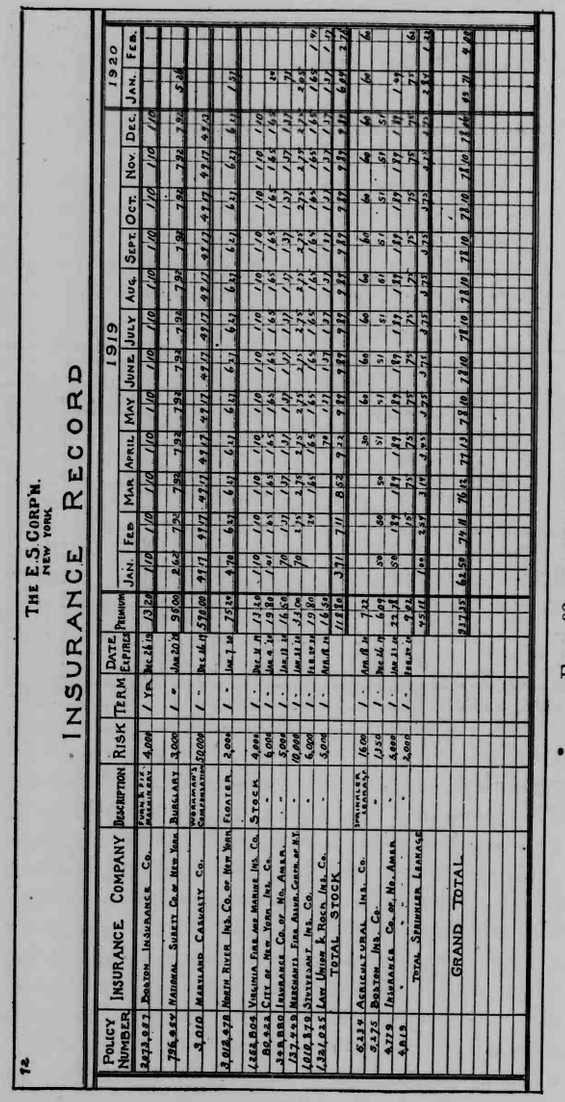
Broker Tiffe Form

Address 210 Main St.

Date	Amount		Balance		Date	Amount		Balance	
Jan. 1			150		Oct. 31	12	50	25	
Jan. 31	12	50	137	50	Nov. 30	12	50	12	50
Feb. 28	12	50	125		Dec. 31	12	50	0	
Mar. 30	12	50	112	50					
Apr. 30	12	50	100						
May 31	12	50	87	50					
June 30	12	50	75						
July 31	12	50	62	50					
Aug. 31	12	50	50						
Sept. 30	12	50	37	50					

Form 91. INSURANCE RECORD

in force, it is usually convenient to make use of an "Insurance Record," such as shown in Form 91. Provision is made for writing in a complete description of the policy and also for entering the partial amount of the premium to be written off each month, together with the unexpired portion of the premium remaining. Reference to Form 92 shows that the premium paid was $150 and the term of the policy one year, so that the amount to be written off each month is $12.50. Thus, at the end of the first month the unexpired portion of the premium remaining is $137.50, at the end of the second month $125, and so on. The Insurance Record cards are generally kept filed in a tray so that they can be referred to readily when it is desired to ascertain the monthly charge for insurance. Form 92 fur-



THE E. S. CORP'N.
NEW YORK

INSURANCE RECORD

Policy Number	Insurance Company	Description	Risk	Term	Date Expires	Premium	1919 Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1920 Jan.	Feb.
2,273,083	Boston Insurance Co.	Frame Fire Building	4,000	1 Yr.	Dec. 24 19	132.00	1/10	1/10	1/10	1/10	1/10	1/10	1/10	1/10	1/10	1/10	1/10	1/10		
736,054	Maryland Surety Co. of New York	Burglary	3,000	1 "	Jan. 20 19	90.00	8.62	7.50	7.92	7.92	7.92	7.92	7.92	7.92	7.92	7.92	7.92	7.92	5.38	
3,010	Maryland Casualty Co.	Workmen's Compensation	50,000	1 "	Dec. 24 19	570.00	41.17	41.17	41.17	41.17	41.17	41.17	41.17	41.17	41.17	41.17	41.17	41.17		
3,018,478	North River Ins. Co. of New York	Fighter	2,000	1 "	Jan. 2 19	75.00	4.70	6.31	6.31	6.31	6.31	6.31	6.31	6.31	6.31	6.31	6.31	6.31	1.31	
1,268,806	Virginia Fire and Marine Ins. Co.	Stock	4,000	1 "	Dec. 31 19	12.00	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10		
80,422	City of New York Ins. Co.	"	6,000	1 "	Jan. 4 19	18.00	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	.55	
329,880	Insurance Co. of No. America	"	5,000	1 "	Jan. 13 19	16.50	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	.71	
137,459	Merchants Fire Assur. Corp. of N.Y.	"	10,000	1 "	Jan. 11 19	33.00	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.65	1.10
1,010,370	Stuyvesant Ins. Co.	"	6,000	1 "	Feb. 22 19	19.80	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.10
1,321,015	East Union & Roch. Ins. Co.	"	5,000	1 "	Mar. 8 19	16.50	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37
	Total Stock					112.80	3.71	7.11	8.52	9.12	9.87	9.87	9.87	9.87	9.87	9.87	9.87	9.87	6.25	2.72
6,334	Agricultural Ins. Co.	Implements	16,000	1 "	Jan. 8 19	7.22	.30	.60	.60	.60	.60	.60	.60	.60	.60	.60	.60	.60	.60	.60
9,375	Boston Ins. Co.	"	1,350	1 "	Dec. 16 19	6.09	.50	.50	.50	.51	.51	.51	.51	.51	.51	.51	.51	.51		
6,379	Insurance Co. of No. America	"	6,000	1 "	Jan. 11 19	22.50	.50	.125	.125	.125	.125	.125	.125	.125	.125	.125	.125	.125	1.49	
4,019	" "	"	2,000	1 "	Feb. 22 19	9.00		.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.16
	Total Sprinkler Leakage					45.41	1.00	3.10	2.60	3.73	3.73	3.73	3.73	3.73	3.73	3.73	3.73	3.73	2.84	1.23
	Grand Total					817.35	62.59	74.18	76.13	77.13	78.10	78.10	78.10	78.10	78.10	78.10	78.10	78.10	49.70	4.95

FORM 92. INSURANCE RECORD

nishes a convenient method of summarizing the amount of the premiums which expire monthly. This form is also a good one to use when only a few policies are in force.

In case insurance policies cover different risks, such as buildings, power-plant equipment, raw materials, work in process, and so on, it is necessary to make the entry so as to charge the proper Overhead Expense accounts. Thus, insurance on buildings is chargeable to Building Expense; that on the power plant, to Power Expense; that on equipment to the proper departmental Overhead Expense accounts; and so on, according to the cost accounts in operation. The distribution of employees' liability insurance is on the basis of the payroll. When the books are audited the entries on the Insurance Record should be compared with the policies themselves and the total amount of the prepaid insurance shown on the Balance Sheet verified.

The amount shown in the balance column of the Insurance Record does not represent the cancellation value of the policy because it is assumed that it is the record of a flourishing concern and the most equitable method of distributing the premium is to write it off in equal monthly installments.

The best plan to follow in apportioning the amount of the expired premiums of each period between departments, processes, machines, and so on, is to base the distribution on the plant valuations shown by the Plant Ledger. Usually a reference table of percentages is prepared when making the apportionment. Insurance on raw materials and stock in process is commonly charged to general Factory Expense. It is necessary to make a charge in detail in the subsidiary Expense Ledger to each account affected by the distribution of insurance. It is also necessary to make charges to the controlling expense accounts in the General Ledger.

349. Taxes.— Each month an allowance to cover taxes must be included in the Expense account. If the tax bill has not been received for the year, reference can be made to the one of the preceding year and an estimate then made of the amount of taxes which will accrue each period. An entry has to be made then charging Expense and crediting Taxes Accrued. When the tax bill is received an entry is made charging Taxes Accrued and crediting the Accounts Payable account.

93

THE A. PHONOGRAPH CORPORATION
NEWARK WORKS
SCHEDULE OF FIXED CHARGES
FOR WEEKS ENDED 191.

STATISTICS

	PRODUCTIVE DEPARTMENTS																	MISCELLANEOUS DEPARTMENTS										
	Tool 100	Mach 200	Press 300	Hand Screw 400	Auto Screw 500	Gear Cutting 600	Tube Bending 700	Nickel Plating 800	Polishing 900	Mult'g Reels 1000	Fishing Reels 1100	Tone Arm 1200	Telescop Tone Arm 1300	Sound Box 1400	Motor Spring 1500	Motor 1600	Turn Table 1700	Repair 3000	Power 3100	Building and Grounds 3200	Drafting 3300	Inspection 3400	Packing and Shipping 3500	R.M. Rec. Stores 3600	Process Stores 3700	Outside Trucking 3800	General 3900	Total
Plant Building																												

FIXED CHARGES

	PRODUCTIVE DEPARTMENTS																	MISCELLANEOUS DEPARTMENTS										
	Tool 100	Mach 200	Press 300	Hand Screw 400	Auto Screw 500	Gear Cutting 600	Tube Bending 700	Nickel Plating 800	Polishing 900	Mult'g Reels 1000	Fishing Reels 1100	Tone Arm 1200	Telescop Tone Arm 1300	Sound Box 1400	Motor Spring 1500	Motor 1600	Turn Table 1700	Repair 3000	Power 3100	Building and Grounds 3200	Drafting 3300	Inspection 3400	Packing and Shipping 3500	R.M. Rec. and Stores 3600	Process Stores 3700	Outside Trucking 3800	General 3900	Total
Depreciation Buildings @ %																												

FORM 93. SCHEDULE OF FIXED CHARGES

The best plan to follow for handling the inter-departmental apportionment of taxes on the plant each period is to make the distribution on the basis of the values shown on the Plant Ledger. The procedure is to work out a table of percentages to use when making the apportionment. Income taxes are, of course, a charge to the Profit and Loss account and not to Expense, the reason being that they are payable only out of profits, and they vary according to variations in the gross profits.

350. Schedule of Fixed Charges.— In order to make a calculation of the amount of fixed charges such as depreciation, insurance, and taxes applicable to each period and segregated by departments, it is necessary to prepare a "Schedule of Fixed Charges." A schedule that is used by a phonograph factory is shown in Form 93. Provision is made in the upper portion of the form to record whatever statistical data that are required as a basis for calculating the fixed charges. In the lower part of the schedule the amounts of the fixed charges are calculated.

351. Bookkeeping for Prepaid and Accrued Charges.— The operation of a cost system in a way to provide for including a *pro rata* allowance each period for fixed charges in the expense accounts requires that a certain procedure be followed in the bookkeeping system. The mode of keeping the accounts coming under the head of prepaid expense or accrued liabilities will be explained. Reference will be made first to the plan for handling plant accounts and the reserve for depreciation.

352. Machinery Account.— The description of the mode of keeping a typical plant account will serve to explain how all plant accounts, subject to depreciation, are handled. The Machinery account for a manufacturing enterprise should be kept as follows:

Dr. MACHINERY *Cr.*

1	Appraisal of all machines	X X	31	Cost of old machinery removed from the plant	X X
31	Purchases of new machinery	X X	31	Balance, cost of machinery in the plant	X X
		X X			X X
1	Balance brought down	X X			

Dr. OLD MACHINERY *Cr.*

31	Scrap value of old machinery removed from the plant	X X	31	Cash received from the sale of old machinery	X X
		X X			X X

If this account does not balance after old machinery has been sold, it is necessary to close out any balance remaining to the Profit and Loss account.

Dr. RESERVE FOR DEPRECIATION ON MACHINERY *Cr.*

31	Cost of old machinery removed from plant less scrap value	X X	1	Balance, representing depreciation on machinery	X X
31	Balance, depreciation on machinery in the plant	X X	31	Depreciation on machinery for period	X X
		X X			X X
			1	Balance brought down	X X

353. Plant Valuation.— On the Balance Sheet the balance to the Machinery account is set up on the asset side and the amount appearing in the Reserve for Depreciation account shown as a deduction in order to get the net valuation. Machinery appears thus:

PLANT:

Machinery	$100,000.00
Less reserve for depreciation	20,000.00
Current value	$ 80,000.00

Other plant accounts are handled in a similar way. By following this plan one can tell at any time not only what the plant cost but also its depreciated value. In the above example the cost or original value is shown to be $100,000, and the depreciated or current value $80,000 or ·80 per cent of the cost.

354. Depreciation Fund.— If cash is actually set aside at the end of each period, or invested in securities, for the purpose of accumulating the amount necessary to purchase new machinery to replace the old, it is necessary to open another account. This account

is usually called the Depreciation Fund account. It is operated as follows:

Dr. DEPRECIATION FUND *Cr.*

31	Cash or securities deposited in the depreciation fund	X X	31	Payments for new machinery to replace old machinery	X X
31	Interest on depreciation fund balances and securities	X X	31	Balance available for the purchase of machinery	X X
		X X			X X
1	Balance brought down	X X			

The adoption of the sinking-fund method of handling depreciation requires the establishment of a separate fund. In that case interest earnings on the depreciation-fund bank balances and securities are deposited in the fund. If the reserve for depreciation is $20,000, as in the foregoing example, the balance in the depreciation fund should also be $20,000.

355. Insurance Prepaid Account.— Insurance premiums when paid are charged to the Insurance Prepaid account. Then at the close of each accounting period the amount of the expired premiums is credited to the account. The balance after making this entry then represents the amount of the unexpired insurance premiums as follows:

Dr. INSURANCE PREPAID *Cr.*

31	Payments for insurance premiums	X X	31	Amount of insurance premiums which have expired	X X
			31	Balance, unexpired portion of insurance premiums	X X
		X X			X X
1	Balance brought down	X X			

356. Taxes Prepaid or Accrued Account.— Taxes when paid are charged to the Taxes Prepaid or Accrued account. The account

is credited at the close of each period for a *pro rata* allowance for a year's taxes. If the account has a debit balance the taxes appear as being prepaid on the Balance Sheet, and if the account has a credit balance the taxes appear as having accrued. The operation of a Taxes account is as follows:

Dr. TAXES PREPAID OR ACCRUED *Cr.*

31	Payments of tax bills	X X	31	Pro rata allowance for taxes for period	X X

357. Summary.— Fixed charges, therefore, must find their way into the Overhead Expense accounts so that they can be applied as a burden to the product. The calculation of the amount of the fixed charges to be included in the expense accounts of each period is best accomplished by means of a schedule which shows the basis of finding each fixed charge, and the various amounts which are applicable to the period.

QUESTIONS ON CHAPTER XXV

1. What is meant by fixed charges? Name three items coming under this head.
2. Define: (*a*) depreciation, (*b*) obsolescence, (*c*) wear and tear, (*d*) expired capital outlay, (*e*) replacements, (*f*) scrap value.
3. What purpose is served by a detailed record of the plant investment?
4. How is depreciation calculated under the following three methods: fixed-proportion method; fixed percentage on diminishing value method; sinking-fund method?
5. What are the advantages and disadvantages of each method?
6. What is meant by depletion?
7. How is a reserve for major repairs operated? Give an example.
8. Should copyrights, patents, trademarks, and brands be depreciated?
9. How should prepaid insurance premiums be handled? What records are required?
10. What provision should be made in the accounts to cover taxes?
11. What is meant by a schedule of fixed charges? For what purpose is it used?
12. What entries are made on the Ledger at the end of each accounting period to cover the depreciation, insurance, and tax expense?
13. How is a depreciation fund operated?

CHAPTER XXVI

INTEREST

358. Profit.— A merchant usually adds transportation charges to the amount of the vendor's invoice in order to find the cost of goods laid down in the store. This is frequently referred to as the "C. L. D." cost (cost laid down). The manufacturer figures the cost of finished products delivered to the shipping department or finished goods stockroom. This is called the factory cost. After the cost of merchandise is known the merchant or manufacturer must proceed to determine upon the selling price for the commodity. In fixing the selling price it is customary to allow a margin above the cost sufficient to provide for a reasonable interest return upon the investment and in addition to give the proprietors a profit to compensate them for assuming the risks of the undertaking and to reward them for their superior skill in judging the market and in operating their plant. The reason, of course, that a business man puts his capital into some undertaking is because he expects to obtain a larger return from his investment than if he loaned his money to others at prevailing rates of interest. Nevertheless, if he took no risks and if he displayed no skill whatever — indeed refrained from applying his resources to industry — but simply put them to some other enterprises upon gilt-edge security he would receive interest upon his capital in proportion to the time during which he permitted the other man to command it.

359. Turnover.— It is certain that a business man will be influenced by the amount of the investment required when making a decision regarding any new undertaking. Suppose that the relative merits of two manufacturing processes for tanning leather are being considered. The first process requires four months to convert green hides into sole leather while the second process requires only two months. By adopting the second process the capital tied up in hides in process can be turned over twice as fast as if the first process

were adopted. If interest were omitted from the calculation, it is likely that the cost of production might be about the same in either case. However, the proportionately greater yield on the investment made possible by introducing the shorter tanning process would appeal to the business man.

360. **Investment Yield.**— Machinery is continually being scrapped and new equipment introduced in order to obtain greater production with a consequently greater turnover in the working capital and increased yield on the investment. Recently the manager of a large shoddy mill scrapped the entire equipment used for the carbonizing process, although it had been in use for only five years, to install new machinery which would give a greater production. It was estimated that the interest charges on the capital outlay required and additional depreciation on the new equipment would be more than offset by the increased earnings after the replacement had been made. Unless a business man can make his capital earn more than he could by leaving it tied up in some conservative investment, it would be foolish for him to undertake the risks of a business enterprise.

361. **Plant Values.**— If a manufacturer is selling the products from two departments, one of which is equipped with heavy and expensive machinery while the other represents but a small investment in equipment, it is certain that he will charge relatively more for the article made on the large machines. A job printer who operates one department equipped with five web printing presses costing $35,000 each, including attachments, considers the large investment in equipment when selling the "press hours." On a six per cent basis the printer would be entitled to about $1 per press hour to cover interest charges. In addition to this he would probably add $2 or $3 to repay him for undertaking the business. Otherwise he would not consider the business profitable.

362. **Interest and Rent.**— It frequently happens that a manufacturer becomes his own landlord, in which case he does not pay rent to any one else. However, this does not mean that he can afford to sell his goods any cheaper. In determining upon the selling price of the commodity the manufacturer should include and distribute as overhead not only all current carrying expenses but also a rent equivalent or sum that would in a series of years amortize the

original construction cost and pay proper interest on the purchase price of the land. In this connection it is well to call attention to the need of considering the element of interest as well as amortization charge when comparing costs in an owned plant with those in a rented plant. For example, there are two silk-throwing mills, one of which is owned and one of which is rented. In order to make a comparison of operating efficiency, from the standpoint of costs, it is necessary to include the element of interest in the calculation of both. Otherwise the cost of making Georgette crêpe would appear to be excessively high in the mill which is rented, though that mill may actually be the more efficient of the two. For statistical work, such as cost comparisons made by the Tariff Board between mills in the same industry, it is usually necessary to consider the factor of interest on plants owned as an offset to the rent factor on plants which are not owned.

363. **Comparisons with Cost of Outside Service.**— Sometimes the question arises as to whether a manufacturer can furnish his own light and power service as cheaply as he can purchase it from a public-service company. In making a comparison of this kind it is logical to include interest on the investment in the lighting or power plant required to produce the service. Otherwise the manufacturer might be misled into making a considerable investment on which he would get no return in excess of a reasonable rate of interest on the capital tied up in the lighting or power plant.

364. **Interest May Not Be Included in the Balance Sheet.**— In making any calculations which involve consideration of the interest factor care must be taken not to add the interest to the cost of merchandise laid down in the store or the cost of producing the factory product. A merchant inventories goods at the "C. L. D." price, and the manufacturer at the cost of production, unless the market price is lower. To include interest as a part of the inventory value of the commodity would be to anticipate the margin, above the cost, provided for interest. The American Institute of Accountants has ruled that an auditor may not certify a Balance Sheet in which some of the assets include an interest charge. One must, therefore, be careful in arranging cost figures not to include the element of interest in any Balance Sheet asset. In a large woolen mill costing $1,000,000 the interest charge at six per cent would be

10 cents per yard on a production of 600,000 yards annually. If the cost sheets show that a fabric costs $2 a yard to make, the manufacturer would value the fabric, including interest, at $2.10, as a guide in fixing the selling price.

365. **Summary.**— For the purpose of making comparisons between the efficiency of owned and rented plants from the standpoint of costs, between the relative profitableness of different manufacturing processes, and between the cost of inside service and that supplied by outside service companies, it is necessary to consider the interest factor. The margin between the cost and selling price should be sufficient to provide for an adequate yield on the investment and also leave a sufficient balance to compensate the enterpriser for assuming the risks of the undertaking. Assets upon the Balance Sheet may not include interest. The reason for this in practice is that no man can properly presuppose the gilt-edge character of the investment of his own money in his own enterprise.

Questions on Chapter XXVI

1. Does a manufacturer or merchant include interest as a part of the cost of merchandise?
2. Is interest included in the selling price?
3. Does a business man expect to obtain a larger yield on his investment by going into business for himself than he would obtain if he loaned his money to outsiders?
4. What is the relation of turnover to profits?
5. In making a comparison between the cost of production in different plants, one of which is owned, and one of which is rented, is it necessary to take interest into consideration?
6. In making a comparison of the cost of inside service with quotations from outside service companies is it necessary to include interest in the calculations?
7. May interest be included in the cost of merchandise when setting up a balance sheet?
8. What is the cost per square foot of rentable area in an office building where the expenditures were as follows: insurance, $283; improvements, $253; miscellaneous, $4,327; agents' commissions, $3,266; decorating, $5,606; repairs, $829; supplies, $259; water, $460; electricity, $3,024; labor, $8,939; fuel, $2,467; taxes, $18,560; interest on mortgage, $50,000. The rentable area is 200,000 sq. ft.

CHAPTER XXVII

APPORTIONMENT OF MISCELLANEOUS SERVICES TO OPERATING DEPARTMENTS

366. **Service Departments.**— In nearly every plant there exist such services as repairs to plant, supplying power, providing space for manufacturing, and general supervision. The expense of providing these services is a general charge against the manufacturing and selling departments. It is, therefore, necessary to close out the miscellaneous services to the manufacturing and selling department accounts, as provided for in the Chart of Expense Account Classifications (Exhibit Z). It will be observed that these accounts also include current charges and items that are fixed charges. Thus, in "Department A, Operating Expense," one finds provision made in the chart for a portion of the repairs, power, building and occupancy, and general and office expense. The proper method to follow for apportioning miscellaneous services to operating and selling departments is the next matter to be considered.

367. **Repairs.**— When a staff of millwrights, carpenters, electricians, and plumbers are employed for the purpose of making repairs about the plant, it is necessary to make an apportionment of the services they render. The plan usually followed is to provide that the master mechanic or foreman of the repair department make a report at the end of each day or week showing what work has been done and the time spent. The code given in the Chart of Expense Account Classifications (Exhibit Z) can be used for reference when indicating what accounts are to be charged. The time of a millwright who has been aligning the shafting in Department B would be charged to account 1214 as shown by the Chart (Exhibit Z). At the end of each accounting period the balance to the Repair Department Expense account should be transferred to operating-department accounts.

368. **Power.**— If a power department is operated in connection with a manufacturing plant, it is necessary to make a distribution

of the power expense to other operating departments. The usual practice is to base the distribution on the horse-power hours. If Department A runs 250 hours a month and requires 1,000 horse power, and Department B 200 hours and requires 500 horse power in a plant with two operating departments, the apportionment would be 71.43 per cent to Department A and 28.57 per cent to Department B as follows:

Department	Horse Power	Hours	Horse-Power Hours	Per Cent
A	1,000	250	250,000	71.43
B	500	250	100,000	28.57
			350,000	100.00

If all the departments run the same number of hours, the apportionment can be made directly on the basis of the horse power. At the close of each accounting period it is necessary to transfer the balance of the Power Expense account to the various operating-department accounts.

369. Building and Occupancy Expense.— Expense is incurred for the purpose of providing space required for manufacturing and selling departments. If the proprietor of the enterprise is his own landlord, the building and occupancy expense will consist of a number of items such as wages of cleaners, cleaning supplies, repairs to the building, and fixed charges on the building, which should include a rent equivalent great enough to give interest on the cost of the land and an amortization charge on construction. In the event that such an owner had mortgaged his land and buildings for 80 per cent of their cost his fixed charge would be made up to the extent of 80 per cent to the amount paid to the mortgagee. In case the plant is rented, the landlord's rent bill will take the place of certain of the building expenses. In either case, however, it is necessary to make a distribution of the expense of occupancy to the various manufacturing and selling departments using space. In order to obtain the data required for the purpose of making the distribution it is necessary to prepare floor-space statistics.

370. Charts Showing Floor Space Used.— Two floor-space charts are shown in Exhibits AD and AE for the purpose of illus-

trating the method followed in apportioning building and occupancy expense. In Exhibit AD the plan of a machine shop is given. The building is 100 feet by 200 feet, making a total area of 20,000 square feet. At the bottom of Exhibit AD the number of square feet used by each department is given for reference when apportioning charges for space used.

Another floor-space chart is given in Exhibit AE showing a different layout. The black areas represent space used for elevators and

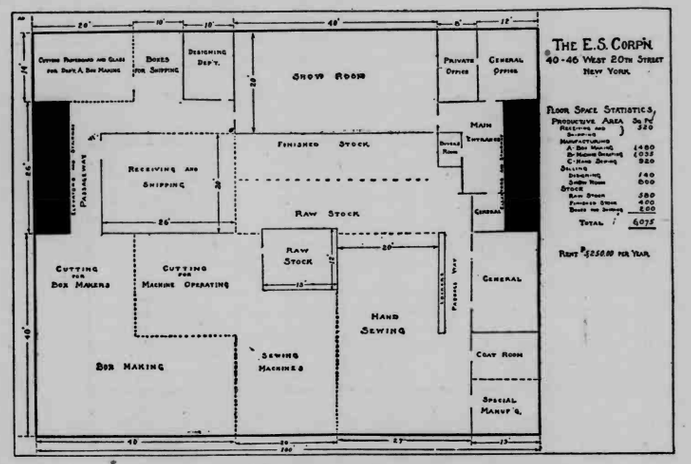


EXHIBIT AD. CHART SHOWING FLOOR SPACE STATISTICS

stairways. At the right the statistics are presented as a guide in making the rental apportionment.

In making the distribution of building and occupancy expense the cost of space or rent is prorated on the basis of the productive area. The productive area corresponds to what real-estate men call "rentable area," all entrance halls, stairways, elevator shafts, and so on being excluded. The cost of building and occupancy service when divided by the square feet of productive area gives the unit charge to cover the cost of space. An apportionment can then be made to each operating or selling department for its share of space service. If all the space is deemed of equal value, the unit charge for space is

the same to one department as to another. However, if space occupied by certain departments is of greater value than that occupied by certain other departments, this condition is one that must be considered.

371. **Lighting Expense.**— Expense incurred in connection with the maintenance and operation of the illuminating system should be apportioned to departments according to the amount of service rendered each. Thus, for example, if nitrogen tungsten lamps of uniform size are used throughout the plant, the cost of light can be

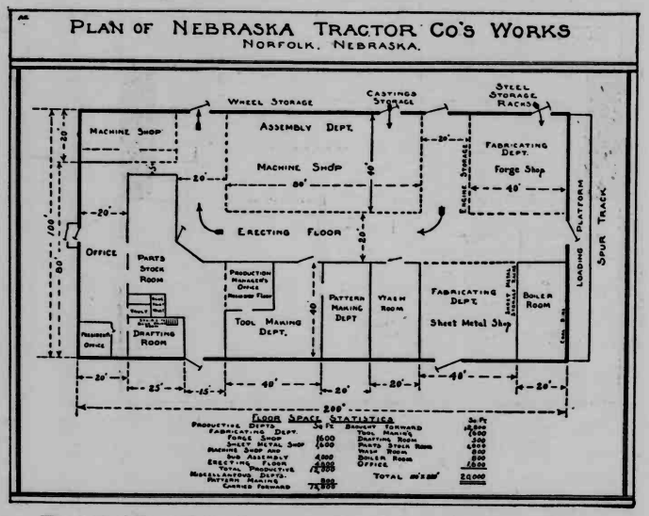


EXHIBIT AE. CHART SHOWING FLOOR SPACE USED IN A FACTORY

equitably distributed on the basis of the number of lamps in each department. In case lamps of different sizes are used, this condition must be considered when making the apportionment. Some illuminating engineers aim to distribute lamps throughout the plant in such a way that there will be an equal intensity of illumination on every square foot of floor space. If this condition prevails, the cost of light can be included with building and occupancy expense and distributed on the basis of floor space.

372. **Heating Expense.**— The same steam plant that provides power usually furnishes the heat required. It is, therefore, necessary to divide the cost of steam between the heating plant and the power plant. The best basis of apportionment is the amount of steam distributed to the heating and the power-generating systems. After the total cost of heat is computed the usual method is to make the apportionment on the basis of productive floor area in which case the heating expense can be included in the Building and Occupancy account. Of course, where there is a wide difference in the heights of various rooms in a plant, or where certain rooms have to be kept at unusual temperatures, special calculations must be made.

373. **Transport Service.**— Manufacturers frequently supply transport service to the various operating departments. There may be industrial railways which transport materials from department to department. In some of the large metallurgical and mechanical industries huge electric cranes are utilized for moving materials; small jib cranes are employed to handle work; and automatic conveyors of one kind or another are installed to expedite the movement of stock. The cost of the transport service must be apportioned to the various manufacturing departments served. In order to do this equitably a careful analysis should be made not only of the cost of the transport service but also of the use to which the service is put, so that each operating department can be assessed the proper amount, according to some principle following from the circumstances just mentioned.

Under certain conditions there will likely be services other than those mentioned, the costs of which must be apportioned to the various operating departments. The description of the methods above given for distributing the cost of certain services is suggestive of various plans which can be followed in making the apportionment.

374. **General and Office Expense.**— The supervision of a plant generally entails considerable expense because there are executive, purchasing, production, accounting, stenographic, and clerical departments, the salaries of which are a charge to general expense. In addition to salaries, there are minor purchases, office supplies, miscellaneous repairs, and fixed charges of a general character in every plant. Since these cannot be charged directly to any operating or service department, it is necessary to charge them to the General

Expense account. Then at the close of each accounting period the balance to the General Expense account has to be closed out to the operating and selling department accounts. Each case must be separately studied to ascertain what portion of the General Expense account should be assessed to manufacturing activities and how much is a charge to the selling department. Usually an analysis of the activities embraced within the General account can be made so as to determine what portion of the general supervision belongs to manufacturing and what part to selling. In some plants the amount of general expense applicable to selling is negligible while in others a half of the total expense of supervision is applicable to selling.

After the amount of general expense chargeable to the factory has been determined the next step is to distribute it to the various operating departments. The best plan for adoption seems to be the one which provides for the distribution of general expense in proportion to the amount of supervision rendered each department. The question naturally arises whether the amount of supervision is in direct proportion to the direct labor, overhead expense, or the sum of labor and expense in the various departments. A hypothetical case may help to make the problem clear:

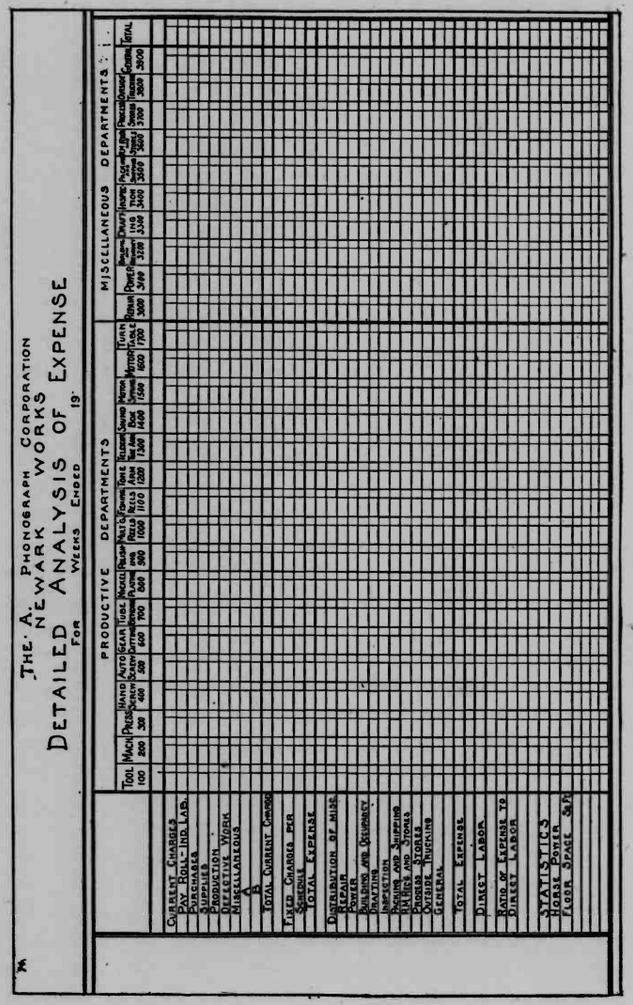
Department	Overhead Expense	Direct Labor	Total Expense and Labor	Percentages		
				Expense	Labor	Expense and Labor
A	$1,000.00	$1,000.00	$2,000.00	17.	33⅓	22.
B	2,000.00	1,000.00	3,000.00	33.	33⅓	33.
C	3,000.00	1,000.00	4,000.00	50.	33⅓	45.
Total..	$6,000.00	$3,000.00	$9,000.00	100.	100.	100.

In the above case it is assumed that the ratio of overhead expense to direct labor is as 1 to 1, 2 to 1, and 3 to 1 in Departments A, B, and C, respectively. The various results obtained by distributing supervision to each department based on (*1*) departmental expense, (*2*) direct labor, and (*3*) the sum of overhead expense and labor is shown in the percentages. If $100 were to be distributed to Department A the amount would be $17, $22, or $33.33, depending upon the basis used. In Department B the amount of supervision assessed under each plan is seen to be $33.33. In Department C the supervision is $33.33, $45, and $50, according to the plan used.

A study of the percentages in the foregoing table shows that when there is a considerable variation in the relation of overhead expense to direct labor, great care should be exercised in deciding the proper basis of distributing the general expense of supervision. If there is a wide variation in the relation of overhead expense to direct labor, the use of percentages based on the sum of overhead expense and labor would seem to be far more preferable than the use of either overhead expense or direct labor as the basis of distribution. However, if a study of conditions shows that overhead expense is relatively small compared with labor, then perhaps satisfactory results can be obtained by apportioning the expense of supervision to departments on the basis of direct labor. In apportioning the expense of supervision it seems as if the value of services rendered in various departments was a better basis than the hours of service.

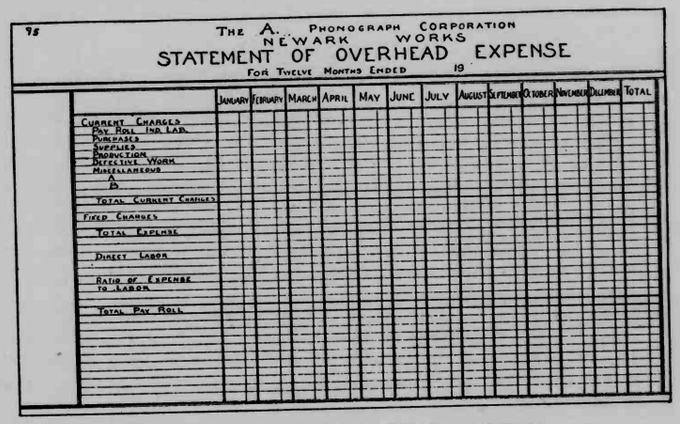
375. **Detailed Analysis of Expense.**— It is the best practice to make use of a columnar sheet for the purpose of analyzing the Overhead Expense account. The sheet used for making a detailed analysis of expense in a phonograph company is shown in Form 94. On the left-hand margin the sources of the information pertaining to expense are shown, while in the column headings the names of all departments are shown. The operating or productive departments are grouped together on the left, and the miscellaneous or service departments on the right, as shown. The indirect labor chargeable to departments for the period can be obtained readily from the Payroll Analysis Sheet, Form 79. The purchases and supplies are found on the departmental sheets in the Expense Ledger and fixed charges are obtained from the Fixed Charges Schedule. The miscellaneous department accounts must be distributed over the operating department accounts. The sheets are then footed and the total expense for each operating department obtained. After the costs of all services rendered production have been apportioned, the distribution of overhead expense to operating departments is complete. The expense of each operating department is thus seen to include direct charges and a proportion of the cost of each service rendered.

In a process factory the direct labor is combined with the overhead expense in order to find the so-called conversion cost. However, in



Form 94. Detailed Analysis of Expense

a job-order factory it is necessary to calculate various departmental rates as a means of distributing expense to jobs as a burden. The method of calculating these rates will be taken up in the next chapter.



Form 95. Statement of Overhead Expense

376. Statement of Expense.— It is a good plan to prepare a summary of expenses as shown in this Statement of Overhead Expense, Form 95, at the close of each year. Such a statement makes monthly comparisons possible and this is a very desirable feature of any accounting system, and furnishes a convenient means of controlling overhead expense.

377. Summary.— It is necessary to segregate all expenses according to producing departments because it is only when operations are carried on that production and time records can be obtained as a means of figuring costs. The complete departmentalization of expense means that all auxiliary services must be distributed to operating divisions of the plant. This complete segregation of expense is best worked out on the Detailed Analysis of Expense sheet.

Questions on Chapter XXVII

1. What is meant by a service department?
2. Name three service departments frequently found in industrial enterprises.
3. How should repair service be apportioned between departments?

4. What is the best method to follow in distributing the expense of power service?
5. How is building and occupancy expense apportioned?
6. How is lighting and heating expense handled?
7. What is the best plan for apportioning general and office expense? Give your reasons.
8. How should transport service be divided between departments?
9. Describe a good form for use in analyzing the Expense account.
10. Of what is the expense of each operating department made up?
11. What is the cost of delivering a package in each zone of the district served by a large New York department store which spends $500,000 a year on its delivery service? The metropolitan district is laid out in six zones which have radii of 1, 1½, 2, 2½, 3, and 3½ miles, respectively. The number of packages delivered in the various zones are as follows: 600,000, 500,000, 400,000, 300,000, 200,000, and 100,000, respectively. The time of the delivery department trucks is spent as follows in the various zones: 7.27%, 14.71%, 19.22%, 22.50%, 21.60%, and 14.70%, respectively.
12. Suggest a plan for distributing factory expense to the product in a large bakery where fancy cookies and sugar wafers are manufactured. Records are kept of the quantity of each kind of material required to make each brand and the number of oven hours required to bake a unit of each brand.
13. Suggest a suitable plan for apportioning the annual overhead expense of general hospital administration of $50,000 over a group of four hospitals, known as A, B, C, and D. The patient days of treatment for the year were 40,000, 50,000, 60,000, and 100,000, respectively.

CHAPTER XXVIII

DISTRIBUTION OF OVERHEAD EXPENSE TO THE PRODUCT

378. Factory Burden.— The process of apportioning factory overhead to the various departments is but a preliminary step to the ultimate distribution of this burden to units of the product. The operating conditions found in each plant determine the type of cost system needed to fit the case and also the requisite procedure in distributing overhead. Let us first direct our attention to a consideration of the relatively simple problem in a continuous-process plant where but a single commodity is produced.

379. Distribution of Overhead in Process Plants.— Our concrete case will be a plant where prepared cocoanut is made by shredding, mixing, drying, and packing cocoanut. All expenses, whether purchases, stores issues, non-productive labor, or fixed charges are charged to one account. At the close of each accounting period the cost per pound for producing prepared cocoanut is calculated. In making the cost calculation the overhead expense is merged with the direct charges to Work in Process for cocoanuts, sugar, glycerine, salt, and productive labor. The result obtained is an average cost per pound.

In a multiple-process factory such as a plant operating a bleachery, mercerizing department, dye house, and print department, it is necessary to allocate all expenses to the process accounts, of which there must be one for each process. The overhead of each of these departmental process accounts is thus merged with material and labor costs. To this must be added also a proper portion of the general overhead for costs connected with administration or any other general service above the department itself. At the end of each accounting period a calculation must be made of the unit cost of production for each process. The result obtained is an average cost for the period. If a product goes through more than one process, such as a fabric which is first bleached and then dyed, it must be charged

for the cost of both processes. If it undergoes three or four processes, it is necessary to include the cost of each process in the calculation of the total cost of production. Thus, it is seen that the problem of burden distribution in a plant where several processes are carried on is also a comparatively simple matter. If all factories were of the continuous-process type, it would always be a simple matter to include a proper amount for the overhead expense in the cost of each unit of the product. However, in job-order factories different conditions are encountered and consequently various expedients have been devised for handling the problem of burden distribution in them.

380. Distribution of Overhead in Job-Order Factories.— Each job in a factory of the job-order variety may follow a course in its travels from the raw-material storeroom to the finished-goods stockroom different from that followed by any other order, and may spend a different length of time in process in each department from that spent by any other job. One job may be in process a day while another may be in process a month. One job may be done on a light inexpensive machine while another job is done on a large and costly machine. When these and all other pertinent conditions are considered, the problem of overhead distribution becomes somewhat complex and special methods must be introduced to apportion overhead expense to individual jobs.

In deciding upon some plan to distribute overhead expense to individual jobs certain conditions will be found to exist. To begin with, overhead expense is measurable in units of time. The expense for a month, quarter, or year is always shown in the analytical statements prepared after the books have been closed. The method of procedure is to see to what extent overhead expense can be applied as a burden to the product so that the amount charged a job will bear a close relation to the time spent in process. Then the problem can be reduced to finding a unit in which to measure time and the amount of overhead expense for the unit decided upon. In working out this problem there are practical as well as theoretical difficulties to be considered.

381. Percentage on Productive-Labor Method.— Reference to the cost-finding plans recommended by the cost committees of over 20 trade associations shows that the plan of applying factory overhead as a percentage on productive labor is the most common method.

Undoubtedly the reason for this is that the plan is easily understood and the ratio of overhead expense to productive labor readily computed. When the percentage on productive labor method is used, it is the best practice to calculate a different rate for each department if local conditions permit this. The procedure followed in calculating these percentages is as follows:

The payroll analysis sheet for the period gives the amount of productive labor in each department and the method of preparing such a sheet has been explained in the chapter on timekeeping and payrolls. At the close of the period the balances to the expense accounts kept with each operating department show the total expenses for each department. From the data contained on the payroll analysis sheets and the expense accounts a calculation can be made readily showing the ratio of expense to labor in each of the operating departments. The method is the same whether a factory consists of one or many departments. When this plan is used, it is expected that by adding a fixed percentage to the direct labor cost reported against jobs in any particular department the overhead expense of the department will be equitably apportioned among the various jobs.

The assumption made by advocates of the percentage on productive labor method is that the amount of departmental labor charged directly to particular jobs is a fair measure of the length of time which a job spends in process in a department. This is, of course, true if the operatives in a department receive the same hourly rates of wages, for then a job with a labor cost of $10 represents twice the time in process of one with a $5 charge for labor. By using a fixed rate for apportioning overhead the former job is assessed twice as much for the services rendered to it by the department such as light, heat and power, floor space, fixed charges, supervision, and so on.

If upon investigation it is found that the equipment in a department is very nearly uniform so that the application of overhead expense by means of a fixed rate on productive labor results in an equitable apportionment of the cost of service to each job and that the hourly wage rates are uniform or nearly so, then the method is simple and accurate enough to give good results. However, if the operatives in a department of a factory are paid different rates of wages, the use of the percentage on productive labor method does *not*

give good results. The reason for this is that the labor cost is not proportional to the time spent on jobs. A high-priced mechanic in doing a job may be using a machine similar to one that an apprentice is using. The hourly cost of providing the piece of equipment for the mechanic is no more than for the apprentice, yet if a fixed percentage were to be added to the labor cost of the jobs done by each, the job done by the mechanic would be penalized and the one done by the apprentice favored. Under these conditions some other plan must be adopted as a means of distributing expense to the jobs.

In plants where piece and premium systems of wage payment prevail the operatives usually make an attempt to cut down the time of production to increase their hourly rates of earnings. As pointed out in a preceding chapter the reason why an employer can afford to add a premium or bonus to the wages of an employee who cuts the time of production is because overhead expense is reduced by this cut. An employee who does a job in eight hours which under ordinary conditions takes 10, saves two hours, during which the equipment can be used for other jobs. It is apparent that the employer can afford to pay the employee a bonus for the time thus saved because it is available for more production. It is, therefore, seen from the foregoing that when piece and premium wage systems are introduced into plants, the percentage on productive labor method for distributing overhead expense does not give good results.

If a department in a factory is equipped with a variety of machines, different in size and cost, the use of the percentage on labor method does not give good results even if operatives are paid the same hourly rates. The reason for this is obvious, because one job may take an hour on a large and high-priced machine costing a relatively large amount to operate, while another job may also take an hour but on a small piece of equipment costing a relatively small amount per hour for overhead. When these conditions exist in a department some plan other than the percentage on labor method must be found for distributing expense to jobs.

The foregoing shows that the percentage on productive labor method of distributing overhead expense to jobs is best suited to the needs of a department in which the hourly earnings of operatives are uniform or nearly so and where the equipment is reasonably uniform. Each department in a factory has to be separately considered in order to ascertain whether or not this method can be used. In order to overcome some of the objections raised to the use of the percentage on productive labor method other plans have been devised.

382. Productive-Hours Method.— In a pamphlet regarding cost-finding systems for manufacturers, the Federal Trade Commission recommends the use of the productive-hours method for applying factory overhead as a burden on the product. The method consists in using a rate per productive hour for assessing overhead expense as a burden. The rate is calculated as follows:

A record of the productive labor hours has to be kept for each department in addition to the amount of direct labor. The productive hours divided into the expense of the department for the period gives the hourly rate for distributing expense when figuring costs.

The use of the productive-hours method removes the effect which the premium or bonus paid the operative has on the result. This is because the time taken on a job, regardless of the rate paid operatives, is the basis for the apportionment. If the equipment used by the operatives is generally uniform, the productive-hours method gives good results. However, if the equipment varies widely in size and price, the same objections which apply to the percentage on productive-labor method also apply to this plan.

There is more clerical work involved in working the productive-hours method than in using the first method because the hours have to be reported in addition to the value of the direct labor on jobs. This adds to the routine of operating the cost system and it is for this reason that many practical manufacturers advocate the use of the percentage on productive labor method.

In some plants the ratio of expense to direct labor is very high, in which case the discrepancies which result from the use of percentage rates are more pronounced than they are in factories where the ratio is low. It is apparent that on the final cost calculation the result of penalizing one job and favoring another is less when a rate of perhaps 15 per cent is used than when rates of 100 per cent or more of productive labor prevail. When the ratio of a department's expense to productive labor approaches or exceeds 50 per cent, the percentage on productive labor method should never be used unless all of the operating conditions are favorable to it. Whenever the

ratio of expense to direct labor is high, the argument that the introduction of the productive-hours method will increase the clerical expense should not be heeded if conditions indicate that the method is best adapted to meet the needs of the case.

383. Percentage on Prime Cost Method.— The cost committee of the National Association of Carriage Manufacturers adopted the plan of applying factory overhead as a percentage of the prime cost. The committee reported that it believed this plan would give the best results in their business. The method of procedure is as follows: The payroll is analyzed into direct and indirect labor, on the one hand, and all purchases and stores issues are divided into direct and indirect materials and sundry charges on the other. Then the sum of the direct labor and direct material used gives the prime cost for the period, and the sum of the indirect labor and indirect charges plus depreciation gives the overhead expense. The prime cost for the period as above ascertained is divided into the indirect expense in order to find the percentage to be added to the prime cost of a job to cover overhead expense when figuring the cost of production. It is the practice in the marble industry to add overhead to the prime cost on a percentage basis. The reason given for this practice is that a large part of the non-productive labor is engaged in handling the blocks and slabs of marble.

This plan of applying overhead to prime cost should only be used in plants where a study of local conditions indicates that the ratio of material to labor is about the same for one job as for another. It might be argued that in many plants there are many items in the Overhead Expense account which have no connection with the cost of material. If this condition prevails and overhead is assessed as a percentage on prime cost, it is likely that two articles requiring similar processes but made of differently priced materials would be assessed a different amount for overhead expense. In order to overcome this condition the method is frequently modified.

A different rate is sometimes used for applying overhead expense to material from that used for applying overhead expense to labor. The operation of this plan requires the analysis of the Overhead Expense account to show just which items are connected with the purchasing, receiving, handling, storing, and inspecting of material, both raw and in process of manufacture. When this plan is followed, the rate on the cost of materials is usually very low compared with that on labor. This modification of the plan adopted by the National Association of Carriage Manufacturers has obvious advantages and in many plants where used gives very satisfactory results.

The application of departmental overhead as a burden on productive labor has, of course, the same disadvantages here as in the first plan mentioned, except that by isolating material burden a further step toward a scientific distribution of overhead expense is made. If thought desirable, departmental overhead can be applied to jobs on the productive-hours basis instead of on the value of the productive labor.

Whenever the expense connected with the handling of material amounts to more than 10 per cent of the cost of material issued from the storeroom it is a good plan to apply the expense of handling material as a separate burden rate by means of a percentage on material. This plan removes one element from the percentage or hourly burden rates and tends to make the final cost calculation more accurate. If the expense incurred in connection with handling material is not applied as a separate burden, it must be prorated together with items of a general nature over the various operating departments. If the amount of material expense is relatively small, there is, of course, no great objection to the plan of including the expense of handling material as a general charge to the expense accounts of operating departments.

384. Sold-Hours Method.— The associations of printers, lithographers, paper-box manufacturers, and other producers of similar lines have adopted what is called the "sold-hours" method of cost finding. In some cases the method is spoken of as the "productive-hours" plan. The Printers' Cost Commission was the first to give publicity to this plan and they call it the sold-hours system and it will be referred to by that name in this work. The method consists in ascertaining the cost of each hour of service rendered customers in the various departments of a factory or subdivisions thereof. The cost per hour includes overhead expense and productive labor. It will thus be seen that this method differs radically from those previously described.

The principal advantage claimed for the sold-hours method of cost finding is that it enables the manufacturer to calculate easily a rate

for the service rendered by each department and to use the rate not only in figuring the cost of jobs but also for estimating on new work. In those industries in which the method is used extensively the bulk of the product is estimated before the order is obtained from the customer. Thus, in a printing or lithographing establishment it is important that the cost system provide a means for readily estimating jobs. It is also desirable that after the cost of a job has been figured the actual cost be compared with the original estimate in order to ascertain whether or not the estimated cost of work done by any department has been exceeded. The sold-hours method of cost finding provides an admirable means of meeting the requirements of those manufacturers who want a simple method of cost finding and estimating.

In order to compute the hourly rates to be used it is first necessary to obtain from the payroll analysis sheets the cost of productive labor in each department for the period. The expense for the period is obtained from the Ledger accounts kept with each department. Then the sum of the productive labor and expense for any department is divided by the productive hours, which are also obtained from the payroll analysis sheet, in order to obtain the cost per sold hour. The operation of this method requires that the productive hours be reported against each job as it passes through the various operations. With this information and a schedule of hourly rates it is an easy matter to figure the cost of the service rendered by each department to the job. At the end of each accounting period it should be the practice to prepare a statement showing the actual cost of running each department compared with the amount that was billed out for its services.

The report of the cost committee of the Pulp and Paper Manufacturers' Association recommends the use of machine-hour rates, to include the wages of the operative and the overhead expense, for the purpose of applying the expense of operating the machines used in a paper mill. Reference should also be made to the practice of including the wages of the operative with the expense of the machines in an automatic-machine department, such as a screw-machine department. It is obvious that when one operative tends a whole group of machines, he cannot report his time against any one job, and so the only alternative is to report the time of the machines on jobs, and

to extend this time at a rate which covers both expense and the operative's wages.

With reference to the expense incurred in connection with handling material in a sold-hours system, there are two ways of treating the matter. One method is to consider the stockroom as a department in itself and to keep the expense of handling material separate. The overhead expense of the stock department is then disposed of as a percentage on the cost of material issued to jobs. The other method is to treat the cost of handling stock as a general-expense item and to prorate it over the various operating departments in the same way that general expenses are handled. In case the expense incurred in handling material is relatively large, the former method should be adopted in the interest of accuracy, but if the amount is relatively small, for example only three or four per cent of the cost of material issued to jobs, the latter method is the best one to use.

385. **Production-Center Method (Machine Hours).**— A salient feature of the mechanical industry is the use of machinery, much of which is high priced. In any one department of a large or small shop there is likely to be a wide range in the cost of individual machines. Thus, for example, in a punch-press department the presses are likely to vary in size, weight, and cost to such a great extent that there is no similarity between the cost of running the different size presses. It is, therefore, apparent that if a department rate is used for assessing overhead expense as a burden on the product, certain jobs will be penalized while others will be favored. In order to remedy this condition of affairs much publicity has been given to the production-center, or process-center, method of burden distribution. The plan is simple in conception. The underlying idea is to consider the factory operating departments for cost purposes as made up of a number of little homogeneous production centers. The cost of operating each of these centers is to be computed as if the production center were a little shop isolated by itself. A record of the machine hours for the center has to be kept in order to ascertain the hours spent on productive work. The total hours thus found divided into the overhead expense for the center gives the cost per hour. Each hourly rate is indicated by code letters affixed to the machine and used by the timekeeper in reporting the number of hours spent on the job. When costs are figured in the shop-cost department all that is necessary is

to get the total operating hours of the machines of each class on the job. Then with this information and the schedule of hourly rates it is an easy matter to extend the hours in order to find the total overhead or machine expense on the job. The total overhead which is applied to or absorbed by the product during any given period should be equal in amount to the total machine expense shown on the subsidiary Expense Ledger under the head of "machine expense." In this connection it should be noted that the overhead expense of the stock and special manufacturing departments is kept separate from that of the machine departments, separate burden rates being used for applying the overhead, as a percentage on the cost of material, rate per hour, and so on.

In making the calculation of the overhead of production centers the same problems are encountered that are met with in making the calculation of departmental hourly burden rates. The only difference is that there have to be as many production centers as there are varieties and sizes of machines in the plant. That is, instead of perhaps 10 departments in a manufacturing establishment organized along functional lines, there may be a thousand machine classifications, for each of which a rate per hour has to be computed. There are, of course, not so many different rates as there are machines, for a 50 cent rate may apply to a plain milling machine, a hand-screw machine, and a punch press. However, the preparation of the data necessary to figure the rates for a large shop is no small job and it is for this reason that so few factory managers are willing to go to the expense of introducing the production-center method.

This system necessitates a complete classification of the machinery. Beginning with the metal-working machines, the different types of metal-working machines have to be enumerated as lathe types, milling machines, grinders, saws, and so on. Then under lathe types would come plain engine lathes, hand-screw machines, and other types; under milling machines there would be plain milling machines, vertical milling machines, universal milling machines and so on, and each class would be still further subdivided. Thus, plain engine lathes would be grouped according to length and the diameter of the piece which can be turned, plain milling machines would be subclassified according to the horizontal, vertical, and longitudinal table adjustments. Thus, it is seen that the production centers in any good

sized shop would be large in number. A code symbol should be assigned each class, the make up being somewhat as follows:

M	Metal-working machines
M L	Lathe types
M L E	Engine lathes
M L E A	5 ft. bed, 4″ swing engine lathes
	etc.

If the rate was fixed at $0.50 per hour, the cost department would know that when M L E A was reported on a time ticket the rate of $0.50 was to be used for extending the cost of the time the machine worked on the job.

In connection with the production center method attention is called to the matter of disposing of any general expenses in a factory that do not have any direct connection with the operation of individual machines. There are two plans of handling these general charges. One plan is to make an arbitrary division of them among the various production centers, and to include the general-expense charge in the hourly rate. The other plan is to apply the general factory expense to the cost of production by means of a supplementary rate, usually on a percentage basis, using the overhead already applied or the factory cost as the base. Individual conditions must, of course, be carefully studied to learn just what plan meets local needs. Unless there is some good argument to the contrary it would seem best to include the general expense with the machine rates in order to save clerical work when making cost calculations.

A good example of the application of the production-center method for the purpose of applying burden is found in the knit-goods industry. In a knitting mill such as a hosiery mill, the cost per period for overhead expense per knitting machine can be found readily. This is done by dividing the number of knitting machines into the overhead expense. Of course, if different types or sizes of machines are used, it is necessary to take this condition into account and calculate a different rate for each class of machine. For each style of hosiery the machines have a certain rate of production, the finer the grade the longer it takes to produce a dozen pair. Therefore, knowing the number of pairs which can be produced in any one period, together with the overhead expense for the machine, it is an easy matter to find the cost per dozen for overhead expense.

Attention should also be called to the method used by field agents of the Tariff Board for disposing of overhead expense in the textile industry. In spinning mills producing fine grades of yarn, the method of procedure is to ascertain the overhead cost per spindle. Then the amount of overhead chargeable to any one style of yarn is found by multiplying the rate for one spindle by the total number of spindles on the style. The total overhead thus found, divided by the pounds of yarn produced gives the overhead per pound for the particular style. The finer the yarn the greater will be the overhead cost per pound.

In a weaving mill the field agents made use of what is called the "loom-day" system of distributing overhead. The plan consists in dividing the total loom days for the period into the weaving-mill overhead. Thus, if there were 25 working days in the period, and 100 looms in operation the loom days would be 2,500. After the cost per loom day has been calculated the overhead cost on each fabric can be found readily by multiplying the rate for one loom day by the number of days the warp was being woven on the loom. The number of yards divided into the total overhead charged to the fabric gives the overhead cost per yard. The finer the cloth the longer it takes to weave and the greater the overhead cost per yard of the finished fabric.

386. Quantity of Output Method.— In considering various methods of expense distribution reference should be made to the practice sometimes followed of basing the apportionment on the quantity or weight of the product. Take, for example, a cannery where several kinds of goods are being packed. It is obvious that the most equitable method in apportioning overhead expense is on the basis of the number of cans. In the bottling business overhead expense can be apportioned on the basis of the number of cases of each kind of goods produced. When an examination of the conditions existing in any plant indicates that weight furnishes the best basis for distributing expense some unit such as pounds, or tons, should be used for the apportionment. In an iron foundry it is the standard practice to apportion general expense on the basis of the weight of good castings produced. In actual practice many cases will be found where weight furnishes a convenient basis for distributing expense.

387. Selling Expense.— The methods of disposing of selling expense, or commercial burden as it is sometimes called, have not yet been explained. It is quite usual for business men to say that their selling expense is a certain per cent of their sales. The reason for this is that the expense incurred in selling an article is supposed to bear a close relation to the selling price. For instance, if the selling expense for a period is $25,000 and the sales $100,000, the expense is said to be 25 per cent of the sales. It is also customary to calculate a separate percentage for the selling expense on the sales of each department of a business. Thus, in a department store the expense of conducting the business is separately ascertained for each department and then the ratio of the sales to the expense of each department found.

A more desirable method is to state the ratio of selling expense to the cost of the product handled. For example, if the selling expense for a period was $25,000, and the cost of sales $75,000, the percentage of expense to cost is 33⅓. The use of this method furnishes a basis of calculating the cost to make and sell. If an article costs $1 and sells for $2 the profit is $0.66⅔, the difference between the total cost ($1.00×33⅓%) and the selling price of $2.

In factories where the production is uniform in quantity or weight, selling expense can usually be stated as a rate per unit of quantity or weight. Thus, in an iron foundry the cost of selling is figured as a rate per pound or per ton of the finished product. The method of apportioning selling expense varies with different conditions. However, in general the plan is to distribute selling expense over the product, first departmentalizing sales and selling expense if deemed advisable.

388. Summary.— From the foregoing it is understood that there are a number of methods which can be used for applying overhead expense to the product. In continuous-process plants the overhead expense is usually merged with the direct labor and prorated over the product by process divisions. In job-order plants the overhead expense is assessed as a burden on the product by means of rates and the rates used are supposed to bear a close relation to time spent on the job in production. Selling expense is separated from other expenses and apportioned periodically, usually on the basis of sales. It is only by making a careful survey of each plant that the cost

accountant can tell just which method is best adapted to meet the needs of the case.

Questions on Chapter XXVIII

1. How is the overhead expense in continuous-process plants apportioned as a burden to the product? Give an example.
2. In case material undergoes several processes during the course of manufacture in a standard-product factory, how is the overhead expense applicable to a unit of the product ascertained? Give an example.
3. In general how is overhead expense measurable?
4. What is meant by the percentage on productive labor method for distributing overhead expense as a burden on the product? How is the overhead rate calculated? What are its advantages and disadvantages?
5. Under what conditions does the percentage on productive labor method for distributing overhead expense give the best results? Can this plan be used in factories where piece and premium systems of wage payment prevail?
6. What is meant by the productive-hours method for diffusing overhead expense? How is the overhead rate calculated? What are its advantages and disadvantages? Wherein is it an improvement over the preceding plan?
7. What is meant by the percentage on prime cost method for disposing of overhead as a burden? How is the overhead rate calculated? What are its advantages and disadvantages?
8. How can the percentage on prime cost method be modified so as to use a different overhead rate on material from that used on labor? What are the advantages of this plan? Under what conditions does the method of using a separate overhead rate on material give good results?
9. What is meant by the sold-hours method for distributing overhead expense? How is the rate calculated? What are its advantages and disadvantages? Under what conditions does it give the best results? Does this plan give good results in a department where automatic machinery is in operation?
10. What is meant by the production-center method for distributing overhead expense? How is the overhead rate calculated? What are its advantages and disadvantages? Give an example of an industry where the plan gives good results.
11. What is meant by the quantity or weight of output method for distributing overhead expense as a burden to the product? What are its advantages and disadvantages? Give an example.
12. What is meant by the estimated burden rate method? How is it operated? Give an example.
13. What is covered under the heading of selling expense? On what basis is selling expense best apportioned? Give an example.

CHAPTER XXIX

COST ARITHMETIC CONNECTED WITH BURDEN RATE CALCULATIONS

389. Illustrative Examples.— In order to explain the procedure followed in calculating rates for distributing overhead expense as a burden on the product several concrete examples will be presented. The problem of making the calculation of burden rates will be presented with the use of various schedules each of which contains certain data needed for the calculation. Information contained in the schedules is such as the cost accountant obtains from various books and accounts kept for recording business transactions. The presentation of the method of calculation will be made in non-technical form, that is, without the use of debit and credit entries. The bookkeeping features of the problem of distributing overhead expense as a burden will be taken up in detail in subsequent chapters. The schedules and calculations given are akin to the working papers used by cost accountants for calculating burden rates.

390. Hourly Burden Rates in an Optical Goods Factory.— The first case to be considered is the method of calculating hourly burden rates for each department in an optical-goods factory. The factory has an administrative department and six operating departments known as the glass-grinding, small-press, automatic-machine, nickel-plating, A assembly, and B assembly departments. It will be necessary to prorate the expense of the factory administrative department, which includes all expense connected with the office and supervision of the plant, over the six operating departments on the basis of the amount of expense and direct labor chargeable to each. In the automatic-machine department the productive labor is added to the total of the expense charged to the department, including a *pro rata* distribution of the administrative expense. The total thus obtained for the automatic-machine department is then divided by the productive machine hours in order to ascertain the rate per productive hour to be used in figuring the cost of work done on automatic

machines. The reason for this is that the time of machines and not that of operatives is reported against jobs in the automatic department. In the five other departments of the factory the expenses charged directly to each plus a *pro rata* of factory administration expense is divided by the productive hours in order to arrive at the hourly rate for apportioning overhead expenses as a burden to the product. The period taken for the calculation is one year and the rates to be determined are for use during the ensuing year.

391. **Purchases Chargeable to Expense.**— Reference to the Record of Purchases furnishes the information needed regarding the amount of any vendor's invoices chargeable directly to expense. These data are given in Schedule 1, as follows:

SCHEDULE 1. PURCHASES CHARGEABLE TO FACTORY EXPENSE

Stationery and supplies	$1,000.00
Factory supplies:	
Glass Grinding	1,000.00
Small Press	800.00
Automatic Machine	1,500.00
Nickel Plating	750.00
A Assembly	300.00
B Assembly	250.00
Total	$5,600.00

Non-Productive Labor.— The payroll analysis for the year gives the amount of non-productive labor as shown in the next schedule.

SCHEDULE 2. NON-PRODUCTIVE LABOR

Factory executives	$3,600.00
Factory clerks	4,500.00
	$8,100.00

392. **Productive Labor.**— In the automatic-machine department it was previously stated that time of productive operatives is included in the hourly burden rates. The payroll for the period gives the direct labor in the automatic-machine department as follows:

SCHEDULE 3. DIRECT LABOR

Department:	
Automatic Machine	$11,870.00

393. **Spoilage and Lost Time.**— A certain amount of spoiled work results from various operations, the cost of which must be included in factory overhead. Lost time of productive workers is also chargeable to Overhead Expense. Factory reports for the period give the amount of spoilage and lost time as follows:

SCHEDULE 4. SPOILAGE AND LOST TIME

Department:	
Glass Grinding	$ 500.00
Small Press	200.00
Automatic Machine	100.00
Nickel Plating	220.00
Total	$1,020.00

394. **Depreciation.**— Depreciation on equipment is figured at the rate of 10 per cent per annum. The company does not own the building used for manufacturing and so there is no depreciation other than that on equipment. Valuations used as a basis for computing depreciation are obtained from the Plant Ledger.

SCHEDULE 5. INVESTMENT IN EQUIPMENT

Department:	
Office	$ 2,000.00
Glass Grinding	6,000.00
Small Press	7,500.00
Automatic Machine	23,000.00
Nickel Plating	6,000.00
A Assembly	3,500.00
B Assembly	2,000.00
Total	$50,000.00

395. **Insurance and Taxes.**— The books of the company show that insurance on equipment amounts to $2,000 a year. This is apportioned on the basis of the investment in equipment.

396. **Distribution of Fixed Charges.**— Depreciation and insurance for the year are apportioned to various departments as shown in the following table. The investment in plant is obtained from the data contained in Schedule 5. A percentage column gives the distribution of the investment in equipment as a basis for apportioning the amount of the insurance premiums on equipment. Fixed

charges when incurred on merchandise are usually debited to General Expense.

APPORTIONMENT OF DEPRECIATION AND INSURANCE

Department	Investment in Equipment	Percentage on Equipment Distribution	10 Per Cent Depreciation on Equipment	Insurance
Office	$ 2,000.00	4	$ 200.00	$ 80.00
Glass Grinding	6,000.00	12	600.00	240.00
Small Press	7,500.00	15	750.00	300.00
Automatic Machine	23,000.00	46	2,300.00	920.00
Nickel Plating	6,000.00	12	600.00	240.00
A Assembly	3,500.00	7	350.00	140.00
B Assembly	2,000.00	4	200.00	80.00
Total	$50,000.00	100	$5,000.00	$2,000.00

397. Rent.— Rent amounts to $25,000 a year, and is apportioned on the basis of productive floor area. By measuring the space occupied by each manufacturing department the area chargeable to each is ascertained to be as follows:

SCHEDULE 6. PRODUCTIVE FLOOR AREA

Department:	Square Feet
Glass Grinding	4,500
Small Press	6,750
Automatic Machine	14,000
Nickel Plating	12,500
A Assembly	7,000
B Assembly	5,250
Total	50,000

A table showing the percentage of the total floor area occupied by each department can now be prepared and the rent apportioned.

APPORTIONMENT OF RENT

Department	Floor Space	Percentage Distribution	Rent
Glass Grinding	4,500	9.0	$2,250.00
Small Press	6,750	13.5	3,375.00
Automatic Machine	14,000	28.0	7,000.00
Nickel Plating	12,500	25.0	6,250.00
A Assembly	7,000	14.0	3,500.00
B Assembly	5,250	10.5	2,625.00
Total	50,000	100.0	$25,000.00

398. Power and Light.— Power costs $4,500 and light $1,200 per year, the former apportioned to the various manufacturing departments on the basis of the average horse power consumed, and the latter on the basis of the average candle power in each operating department. Data required for making the apportionment of power and light are given in the next schedule.

SCHEDULE 7. AVERAGE HORSE POWER AND CANDLE POWER CONSUMED

Department	Horse Power	Candle Power
Glass Grinding	45	200
Small Press	35	150
Automatic Machine	90	300
Nickel Plating	20	200
A Assembly	5	100
B Assembly	5	50
Total	200	1,000

The next step is to prepare a table giving the percentage of the average horse power delivered to each operating department and then to prorate the cost of power accordingly. The result of the calculation is given below:

APPORTIONMENT OF POWER EXPENSE

	Horse Power	Percentage Distribution	Power
Glass Grinding	45	22.5	$1,012.50
Small Press	35	17.5	787.50
Automatic Machine	90	45.0	2,025.00
Nickel Plating	20	10.0	450.00
A Assembly	5	2.5	112.50
B Assembly	5	2.5	112.50
Total	200	100.0	$4,500.00

The same method is followed in making a distribution of light as that pursued in apportioning power.

APPORTIONMENT OF LIGHTING EXPENSE

	Candle Power	Percentage Distribution	Light
Glass Grinding	200	20	$240.00
Small Press	150	15	180.00
Automatic Machine	300	30	360.00
Nickel Plating	200	20	240.00
A Assembly	100	10	120.00
B Assembly	50	5	60.00
Total	1,000	100	$1,200.00

399. Factory Administration.— The total of the factory-administration expense to be apportioned is found, by referring to the foregoing tables, to be as follows:

SCHEDULE 8. FACTORY ADMINISTRATION

Purchases	$1,000.00
Non-productive labor	8,100.00
Depreciation	200.00
Insurance	80.00
Total	$9,380.00

Factory administration is apportioned on the basis of the amount of expenses and direct labor chargeable to operating departments. A summary showing the amount of the departmental expense exclusive of administration expense must be prepared next.

SUMMARY OF DEPARTMENTAL DIRECT EXPENSES

	Glass Grinding	Small Press	Automatic Machine	Nickel Plating	A Assembly	B Assembly
Purchases	$1,000.00	$ 800.00	$ 1,500.00	$ 750.00	$ 300.00	$ 250.00
Spoilage and Lost Time	500.00	200.00	100.00	200.00		
Depreciation	600.00	750.00	2,300.00	600.00	350.00	200.00
Insurance	240.00	300.00	920.00	240.00	140.00	80.00
Rent	2,250.00	3,375.00	7,000.00	6,250.00	3,500.00	2,625.00
Power	1,012.50	787.50	2,025.00	450.00	112.50	112.50
Light	240.00	180.00	360.00	240.00	120.00	60.00
Total	$5,842.50	$6,392.50	$14,205.00	$8,750.00	$4,522.50	$3,327.50

Footings in the foregoing table can now be taken as a basis for apportioning the $9,380 of administrative expense. This is accomplished as shown below:

APPORTIONMENT OF ADMINISTRATION EXPENSE

Department	Departmental Expenses	Direct Labor	Total Expense and Labor	Percentage Distribution	Factory Administration
Glass Grinding	$ 5,842.50	$10,340.00	$ 16,182.50	13.3	$1,247.54
Small Press	6,392.50	15,884.00	22,276.50	18.2	1,707.16
Automatic Machine	14,205.00	11,870.00	26,075.00	21.3	1,997.94
Nickel Plating	8,750.00	10,769.00	19,519.00	16.0	1,500.80
A Assembly	4,522.50	13,939.00	18,461.50	15.1	1,416.38
B Assembly	3,327.50	16,354.00	19,681.50	16.1	1,510.18
Total	$43,040.00	$79,156.00	$122,196.00	100.0	$9,380.00

400. Hourly Burden Rates.— The factory administration expense can now be added to the overhead expense directly assessed against operating departments in order to get the total expense of each department. In the case of the automatic-machine department direct labor given in Schedule 3 must be added to the expense. The productive hours shown in the next schedule can be divided into the departmental totals in order to ascertain the hourly burden rates.

SCHEDULE 9. PRODUCTIVE HOURS

Department	Hours
Glass Grinding	36,192
Small Press	66,196
Automatic Machine	39,566
Nickel Plating	59,828
A Assembly	55,755
B Assembly	51,106
Total	308,643

Hourly burden rates are computed readily as shown in the following tabulation:

HOURLY BURDEN RATES

Department	Departmental Expenses	Factory Administration	Automatic Machine Labor	Departmental Totals	Productive Hours	Hourly Rates
Glass Grinding	$ 5,842.50	$1,247.54		$ 7,090.04	36,192	$0.20
Small Press	6,392.50	1,707.16		8,099.66	66,196	0.12
Automatic Machine	14,205.00	1,997.94	$11,870.00	28,072.94	39,566	0.71
Nickel Plating	8,750.00	1,500.80		10,250.80	59,828	0.17
A Assembly	4,522.50	1,416.38		5,938.88	55,755	0.11
B Assembly	3,327.50	1,510.18		4,837.68	51,106	0.09
Total	$43,040.00	$9,380.00	$11,870.00	$64,290.00	308,643	

It will be seen that it is necessary to add $0.20 to each hour reported against jobs in the glass-grinding department to cover the overhead expense of that department. In the automatic-machine department the rate is $0.71 which is higher than that of the other departments because the productive labor is included. The reason for this is that there is no other means available for assessing the time of the operatives against the jobs done in this department other than that of including their wages in the hourly machine rates. By means of the departmental rates figured it is expected that at the end

of each accounting period the amount of expense for the period will have been loaded on the product as a burden. The bookkeeping entries required in connection with the productive hours method of distributing overhead will be explained in a later chapter.

The foregoing example based on the practice in an optical goods factory for finding the hourly burden rate for each manufacturing department is suggestive of the mode of procedure in other lines of business. Had it been decided to make a calculation of a rate for distributing overhead as a percentage of the direct labor, the money value of the hours would have been used for the divisor instead of the number of hours. This would give the departmental percentages to add to the productive labor reported on jobs in each department, excepting the automatic-machine department in which machine hours must, of course, be used.

401. Percentage of Labor Burden Rates.— In case productive labor was as follows in departments other than the automatic-machine department what would the percentage be?

SCHEDULE 10. PRODUCTIVE LABOR

Department:	
Glass Grinding	$10,340.00
Small Press	15,884.00
Nickel Plating	10,769.00
A Assembly	13,939.00
B Assembly	16,354.00

By referring back to the table showing the hourly burden rates data relative to the total amount of overhead expense for each department are obtained. Percentages to use in figuring costs are then calculated as follows:

PERCENTAGE ON LABOR BURDEN RATES

Department	Departmental Expenses	Direct Labor	Percentage of Overhead Expense to Labor Direct
Glass Grinding	$7,090.04	$10,340.00	68
Small Press	8,099.66	15,884.00	51
Nickel Plating	10,250.80	10,769.00	95
A Assembly	5,938.88	13,939.00	43
B Assembly	4,837.68	16,354.00	30

From the foregoing calculations it is readily seen that 68 per cent must be added to the direct labor reported against jobs in the glass-

grinding department in order to distribute the overhead of that department, and so on for the other departments.

402. Sold-Hours Burden Rate.— Data contained in the preceding tables can be used to make a calculation of "sold-hours" rates if desired. The following table shows the method of calculation:

SOLD-HOURS BURDEN RATE

Department	Departmental Expense	Direct Labor	Total Expense and Labor	Productive Hours	Rate per Hour
Glass Grinding	$ 7,090.04	$10,340.00	$ 17,430.04	$ 36,192	$0.48
Small Press	8,099.66	15,884.00	23,983.66	66,196	0.36
Automatic Machine	16,202.94	11,870.00	28,072.94	39,566	0.70
Nickel Plating	10,250.80	10,769.00	21,019.80	59,828	0.35
A Assembly	5,938.88	13,939.00	19,877.88	55,755	0.35
B Assembly	4,837.68	16,354.00	21,191.68	51,106	0.41
Total	$52,420.00	$79,156.00	$131,576.00	308,643	

It will be seen that the hourly rates are higher in this case than before, with the exception of the automatic-machine department, because direct labor is included in the rates.

403. Analysis of Hourly Machine Expense.— So far no reference has been made in this chapter to the method followed in calculating hourly rates for machines. This is not a difficult matter after unit costs have been established for rental service, power, light, fixed charges, administration, and so on. Reference to Form 96 shows the method of calculation followed in finding the hourly rate for a Pratt & Whitney No. 1 Turret lathe. There are two machines in the group, so the combined cost of running both machines will be calculated and then the cost per hour for one machine obtained.

Rent Expense.— By measuring the floor space occupied by the two machines it is found that 250 square feet are used. The annual rate for floor space is shown by the records to be $0.24 per square foot, which multiplied by 250 square feet gives $60 as shown.

Power Expense.— Meter readings show that 6,500 kilowatt hours are required annually to drive the two machines under normal operating conditions. The rate per kilowatt hour is $0.04, which multiplied by the 6,500 hours gives $260.

Light Expense.— The annual rate for illumination is $0.02 per square foot, which multiplied by the 250 square feet of floor space occupied gives $5.

Fixed Charges.— The accounts show that the depreciation, insurance, and

taxes average 10 cents per dollar of investment. Multiplying this rate by the investment of $1,900 gives $190 as the fixed charges for the two machines.

Tool Expense.— The record kept of tools shows that a charge of $500 should be made against the two turret lathes.

ANALYSIS OF HOURLY MACHINE EXPENSE

CLASSIFICATION. LATHE

MAN'F'R'S. NAME AND TYPE NO. P. & W. NO. 1

STYLE OF MACHINE TURRET

SIZE (Length of Bed X Swing)

NO OF MACHINES IN SHOP 2

EXPENSE	UNIT	QUANTITY	RATE	AMOUNT
RENT	SQ. FT.	250	$.24	$60
POWER	K.W.HRS	6500	.04	260
LIGHT	SQ. FT.	250	.02	5
FIXED CHARGES	$1.00	1.900	.10	190
TOOLS	EST			500
SUNDRY	EST			205
ADMINISTRATION	EA.	2	15.00	30
TOTAL				$1,250

NORMAL HOURS OF OPERATION	2,500
HOURLY MACHINE RATE FOR GROUP	$.50
NO. OF MACHINES IN GROUP	2
HOURLY MACHINE RATE FOR 1 MACHINE	$.25

FORM 96. ANALYSIS OF HOURLY MACHINE EXPENSE

Sundry Expense.— The departmental records of supplies, oils, waste, and repairs show that a charge of $205 should be made against the two machines to cover sundry expense items.

Administration Expense.— This is assessed against machines on the basis of the number of productive operatives working at each machine. The rate is $15 per operative which gives $30 for the two machines.

The total expense for the two machines is $1,250. This amount divided by the normal hours of operation which are reported to be 2,500 gives an hourly rate for the group of $0.50, or $0.25 for one machine.

From the foregoing one gains an idea of the procedure to be followed in calculating the hourly machine rate on any piece of equipment.

404. Summary.— The examples given of burden-rate calculations are suggestive of what steps the cost accountant must take in order to find the rates to be used in distributing overhead expense as a burden on the product in the job-order factories. One who understands the underlying principles upon which the various methods of apportioning overhead are based and who has followed the calculations presented in this chapter should not experience any difficulty in computing the burden rates required in any factory. As a general rule overhead in a department is apportioned to the product on some basis which gives each job or article an amount of overhead proportional to the time spent in process. In the final analysis time is the controlling factor in overhead distribution.

QUESTIONS ON CHAPTER XXIX

1. How is the cost per productive hour in an automatic-machine department handled?
2. What use is made of an analysis of purchases when figuring hourly burden rates?
3. What use is made of an analysis of non-productive labor when calculating hourly burden rates?
4. How are spoilage and lost time handled when computing hourly burden rates?
5. What use is made of the record of plant investment when making an allowance for depreciation?
6. On what bases are insurance and taxes apportioned?
7. How is rent apportioned?
8. How is power and light distributed?
9. What is a good plan to follow in apportioning the administration expense?
10. After the departmental totals have been found how is the hourly burden rate determined upon?
11. If it is decided to distribute overhead expense to jobs as a percentage on productive labor, how are the burden rates calculated?
12. How are sold-hour burden rates determined, after the departmental expense and productive labor are known?
13. What is the method followed in calculating hourly machine rates?

CHAPTER XXX

THE AVERAGE NUMBER SYSTEM OF FINDING COTTON YARN COSTS

405. Short Cut Method for Cotton Yarn Costs.— In many industries the method of calculating costs has to be adapted to meet the peculiar needs of the case. One of these specialized systems of cost finding is found in cotton-spinning mills. Manufacturers of cotton yarn used in weaving plain goods make use of a method of calculating costs known as the "average-number system." In this system it is assumed that the conversion cost (labor and expense) varies directly with the yarn number or yarn size. That is, it is assumed that it takes twice as long to produce a certain quantity of No. 34 as it does No. 17 yarn because the length of yarn in a pound of the former is twice that in a pound of the latter. The reason for this is due to the system in vogue for numbering yarn. A pound of No. 1 cotton yarn contains one hank of 840 yards. A pound of No. 2 yarn contains two 840-yard hanks, and so on. That is, the number of 840-yard hanks in a pound is equal to the yarn number. It is, therefore, assumed that when machinery is producing at a constant rate, the time taken to make one pound of each size of yarn is directly proportional to the yarn numbers. The assumption that the time of production varies in proportion to the yarn number, is approximately true for a moderately narrow range of sizes. There are several advantages which accrue from the use of the average-number system for finding yarn costs and so cotton manufacturers of plain goods quite generally base their calculations on this system. By knowing the cost of an average number of yarn in any mill the manager or agent can compute readily the price of converting cotton into yarn of any number desired. It is thus seen that this system gives a method of quick reckoning not possessed by other cost systems and this accounts for its popularity in cotton-manufacturing centers.

406. Conversion Cost of the Average Number of Yarn Spun. —All single yarn in a cotton mill has to pass through the operations

known as opening, picking, carding, drawing, roving, and spinning. It is, therefore, first necessary to ascertain the average number of single yarn, and then the cost of conversion for the average number, for these processes, that are common to all single yarn. For the purpose of the cost calculation all operations up to and including spinning are grouped under the main operation of spinning. After the cost of spinning the average number has been found, the cost of other numbers can be obtained readily. The procedure in making the cost calculations will be understood by working out a typical case. In the case taken for illustration, yarn is classified either as chain warp or skein yarn. When the yarn for the threads running lengthwise of a woven fabric is prepared for a certain pattern and wound into a ball for shipment, it is called a chain warp. Yarn wound into skeins on reels for shipment is referred to simply as skeins.

Production reports received from the mill give the number of pounds of each size and kind of yarn spun. The first step is to find the average number of yarn spun. This is accomplished as illustrated in the following calculation:

Yarn No.		Pounds	Multiplier	Product
25	Chain Warp	10,000	25	250,000
25	Skein	20,500	25	512,500
2/25	Chain Warp	7,500	25	187,500
2/30	Skein	30,000	30	900,000
36	Skein	5,000	36	180,000
2/40	Chain Warp	15,000	40	600,000
	Total	88,000		2,630,000

2,630,000 ÷ 88,000 = 29.88636 = Average number.

The average number of yarn spun is found by first multiplying the pounds spun by the corresponding yarn numbers, to obtain the sum of the products as above indicated, and then by dividing this sum by the total pounds spun.

The total cost of opening, picking, carding, drawing, roving, and spinning the yarn for the period when the production was obtained was $3,630.

The cost of spinning yarn when divided by the total number of pounds spun gives the cost of spinning a pound of 29.88636 which is the average number:

$3,630.00 ÷ 88,000 lb. = 4.125 cents per lb. for the average number.

In order to ascertain the cost of spinning a pound of No. 1 yarn it is necessary to divide the cost of spinning the average number by the average number, as follows:

4.125 ÷ 29.88636 = .13802283 cents per pound.

To find the cost of spinning any number of yarn all that is necessary is to multiply the number of the yarn by the cost of spinning a pound of No. 1 yarn, as follows:

Yarn No.	Multiplier	Product
25	.13802283 cents	3.4505707 cents
30	"	4.1406849
36	"	4.9688218
40	"	5.5209132

The mathematical accuracy of the work can be proved as follows:

Yarn No.		Pounds	Multiplier Cost of Spinning	Product
25	Chain Warp	10,000		
25	Skein	20,500		
2/25	Chain Warp	7,500		
		38,000	3.4505707 cents	$1,311.2168
2/30	Skein	30,000	4.1406849	1,242.2054
36	Skein	5,000	4.9688218	248.4410
2/40	Chain Warp	15,000	5.5209132	828.1369
		88,000		$3,630.0001

The total cost of spinning the whole number of pounds when extended at the proper cost per pound is $3,630 which proves the correctness of the computations.

The product of the spinning department is single yarn. If ply yarns are wanted, two or more single yarns must be twisted together. If the yarn is for warps, it is wound on large spools called beams. As previously stated, warp yarns run lengthwise of the fabric.

407. Conversion Cost of the Average Number of Yarn Spooled.— Yarn which is to be either warped or twisted must be spooled and so the next step in the calculations is to find the cost of the average number of yarn spooled. In a two-ply yarn—written 2/25 because two strands of No. 25 yarn are twisted together—it is necessary to take it as a 12.5 single after the twisting operation has

been performed upon it. A warp of single yarn has to be spooled only before the process of warping. When warps are wound into balls for shipping, they are called chain warps, because the warp yarn forms a sort of endless chain. A chain warp of two-ply yarn has to be spooled as single yarn, twisted, and spooled again. This makes it necessary to take the two-ply chain warp yarns into the calculations twice for the spooling operation as follows:

Yarn No.		Pounds	Multiplier	Product
25	Chain Warp	10,000	25	250,000
2/25	Chain Warp	7,500	25	187,500
	Chain Warp	7,500	12.5	93,750
2/30	Skein	30,000	30	900,000
	Skein	30,000	15	450,000
2/40	Chain Warp	15,000	40	600,000
	Chain Warp	15,000	20	300,000
	Total	115,000		2,781,250

2,781,250 ÷ 115,000 = 24.18478 = Average number.

The average number of yarn spooled is shown to be 24.18478.

The cost of spooling yarn for the period when divided by the number of pounds spun gives the cost of spooling a pound of No. 24.18478 which is the average number as follows:

$354.98 ÷ 115,000 = .30867 cents per pound of the average number.

In order to ascertain the cost of spooling the unit of number of No. 1 yarn, it is necessary to divide the cost of spooling the average number by the number itself, as follows:

.30867 cents ÷ 24.18478 = .01276298 cents per pound.

To find the cost of each number spooled the procedure is to multiply the number by the cost of spooling a pound of No. 1 yarn, as indicated in the following calculation:

Yarn No.	Multiplier	Product
25	.01276298	.3190745 cents
12.5	"	.1595372 cents
30	"	.3828894 cents
15	"	.1914447 cents
40	"	.5105192 cents
20	"	.2552596 cents

Proof of the accuracy of the computation for the cost of spooling the different numbers of yarn can be made now as follows:

Yarn No.		Pounds	Cost per Pound for Spooling	Total Cost
25	Chain Warp	10,000	.3190745 cents	$ 31.9074
2/25	Chain Warp	7,500	.3190745 cents	23.9306
	Chain Warp	7,500	.1595372 cents	11.9653
2/30	Skein	30,000	.3828894 cents	114.8668
	Skein	30,000	.1914447 cents	57.4334
2/40	Chain Warp	15,000	.5105192 cents	76.5779
	Chain Warp	15,000	.2552596 cents	38.2889
		115,000		$354.9703

The cost of spooling amounts to $354.97, which is within one cent of the amount started with, thus proving the calculation.

408. Conversion Cost of the Average Number of Yarn Twisted.—In order to make ply yarn it is necessary to twist two or more single yarns together as previously stated, and so the cost of twisting is ascertained in accordance with the principles of the average-number system as follows:

Yarn No.		Pounds	Multiplier	Product
2/25	Chain Warp	7,500	25	187,500
2/30	Skein	30,000	30	900,000
2/40	Chain Warp	15,000	40	600,000
		52,500		1,687,500

1,687,500 ÷ 52,500 = 32.1428 = Average number.

The average number of yarn twisted is thus shown to be 32.1428.

The cost of twisting yarn when divided by the number of pounds twisted gives the cost of twisting one pound of yarn of the average number as follows:

$406.87½ ÷ 52,500 = .775 cents per lb.

In order to find the cost of twisting a pound of No. 1 yarn it is necessary to divide the cost of twisting a pound of the average number itself as follows:

.775 cents ÷ 32.1428 = .0241115 cents per pound.

It is now necessary to multiply each number twisted by the cost of twisting a unit of the number.

Yarn No.	Multiplier	Product
25	.024115 cents	.6027875 cents
30	"	.7233450 cents
40	"	.9644600 cents

The accuracy of the computation for the twisting process is now proved as follows:

Yarn No.		Pounds	Multiplier, Cost per Pound Twisting	Total Cost
2/25	Chain Warp	7,500	.6027875 cents	$ 45.209
2/30	Skein	30,000	.7233450 cents	217.003
2/40	Chain Warp	15,000	.9644600 cents	144.669
Total		52,500		$406.881

The cost of twisting amounts to $406.88 which is the same as the amount started with and therefore the computations must be correct.

409. Conversion Cost of the Average Number of Yarn Reeled.— Skein yarn must be reeled and so after the cost of the operations preceding reeling has been figured that of reeling must be taken into the calculations.

Yarn No.		Pounds	Multiplier	Product
25	Skein	20,500	25	512,500
2/30	Skein	30,000	15	450,000
36	Skein	5,000	36	180,000
		55,500		1,142,500

1,142,500 ÷ 55,500 = 20.58558 = Average number.

The average number of the yarn reeled is thus shown to be 20.58558.

The cost of reeling yarn divided by the number of pounds reeled gives the cost of reeling a pound of the average number of yarn 20.58558 as follows:

$22.89 ÷ 55,500 = .412432 cents per pound.

In order to find how much it costs to reel a unit of the number it is necessary to divide the cost of reeling a pound of the average number by the number itself as follows:

.412432 cents ÷ 20.58558 = .002003492 cents per pound.

The cost of each number reeled can now be found by multiplying the yarn number by the cost of reeling a pound of No. 1 yarn.

Yarn No.	Multiplier	Product
25	.002003499 cents	.0500875 cents
2/30 as 15	"	.0300524 cents
36	"	.7212590 cents

The accuracy of the above computation can be proved as in the preceding cases:

Yarn No.	Pounds	Multiplier Cost per Pound Warping	Product
25 Skein	20,500	.0500875 cents	10.2679
2/30 "	30,000	.0300524 cents	9.0157
36 "	5,000	.0721259 cents	3.6063
Total	55,000		22.8899

The cost of reeling as distributed amounts to $22.89 which is the correct figure.

410. Conversion Cost of the Average Number of Yarn Warped.— After the spooling operation is completed, all warp yarn must be wound from the spools onto the warp beam, the cost of which operation is next ascertained by the average-number system as follows:

Yarn No.	Pounds	Multiplier	Product
25 Chain Warp	10,000	25	250,000
2/25 " "	7,500	12 5	93,750
2/40 " "	15,000	20	300,000
	32,500		643,750

643,750 ÷ 32,500 = 19.80769 = Average number.

The average number of yarn warped is shown to be 19.80769.

The cost of warping yarn when divided by the number of pounds warped gives the cost of warping a pound of the average number as follows:

$60.45 ÷ 32,500 = .186 cents per pound.

In order to ascertain the cost of warping a unit of the number it is necessary to divide the cost of warping the average number by the average number itself as follows:

.186 cents ÷ 19.80769 = .00939024 per pound.

It is now necessary to multiply each number warped by the cost of warping a unit of the number in order to ascertain the cost of warping the different numbers as follows:

Yarn No.	Multiplier	Product
25	.00939024 cents	.234756 cents
2/25 as 12.5	.00939024 cents	.117378 cents
2/40 as 20.	.00939024 cents	.1878048 cents

The accuracy of the computations can now be proved as in the preceding cases:

Yarn No.	Pounds	Multiplier, Cost per Pound Warping	Total
25 Chain Warp	10,000	.234756 cents	$23.4756
2/25 " "	7,500	.117378 cents	8.8033
2/40 " "	15,000	.1878048 cents	28.1707
Total	32,500		$60,4496

The cost of warping the various numbers is shown to be $60.45 as required.

411. Appreciating the Values of the Cotton in Yarn.— It is now necessary to find the value of the cotton in the yarn. The cotton used is known as Uplands Middlings 1⅛ inch staple and costs $0.24½ per pound. The ties and bagging in which the cotton was baled weighed 7,039 pounds, and the soft and hard waste, 4,694 pounds. The waste must be deducted from the total cotton opened in order to get the net amount of cotton used, as follows:

	Pounds	Price	Amount
Cotton opened	99,733	$0.14½	$14,461.28
Deduct waste	11,733	0.03½	381.28
Cotton used	88,000	$0.16	$14,080.00

For purposes of illustration it is assumed that no cotton is in process. The cause for the increase in price from $0.14½ to $0.16 per pound lies in the fact that the waste cannot be sold for as much as the cotton originally cost and so it is the practice among cotton-mill accountants to appreciate the value of the cotton in figuring yarn costs.

412. Cost of Yarn Manufactured.— The cost per pound of yarn manufactured can now be obtained by taking all the operations on each kind of yarn made and adding them together, which operation gives the conversion cost. By adding the cost of cotton which was shown to be $0.16 a pound the total cost per pound is obtained. The following table gives the cost of the six yarns made:

413. Proof of Accuracy of Yarn Computations.— The accuracy of the computations up to this point can be proved by extending the pounds manufactured by the cost of production.

Yarn No.		Pounds	Cost per Pound	Total
25	Chain Warp	10,000	20.00440 cents	$ 2,000.44
25	Skein	20,500	19.50065 cents	3,997.63
2/25	Chain Warp	7,500	20.64935 cents	1,548.70
2/30	Skein	30,000	21.46846 cents	6,440.52
36	Skein	5,000	21.04094 cents	1,052.04
2/40	Chain Warp	15,000	23.4389568 cts.	3,515.85
		88,000		$18,555.18

Spinning	$ 3,630.00	
Spooling	354.98	
Twisting	406.87½	
Reeling	22.89	
Warping	60.45	
Cotton	14,080.00	$18,555.19

It is proved that the distribution of costs by the average-number system, comes within one cent of the original amount started with and this is near enough for all cost purposes.

If yarns are not woven in the mill where they are spun, they are put up for shipment in various ways, such as warp chains or skeins, or they may be shipped in the mule cop. The warp chains, consisting of a number of ends of yarn of equal length, parallel to one another, are put up in round or cylindrically-balled chains or on beams ready for use on a loom. The bulk of the skein yarn, consisting of a single continuous thread wound into circular form on a reel, is put up in 10-pound bundles, 40 bundles to a bale of 400 pounds. Each of the 10-pound bundles contains the same number of skeins as the number of the yarn.

The foregoing calculations show that the average-number system for computing the labor and expense of manufacturing different sizes of cotton yarn forms a convenient method for cotton mills making

relatively coarse yarns. This is the method used by the Tariff Board in making their cost calculations in plain goods cotton mills.

Questions on Chapter XXX

1. What is meant by the average-number system of cost finding in cotton-yarn mills? What is the principle upon which this system is based?
2. Illustrate how the cost of spinning is found by means of the average-number system.
3. How is the cost of spooling computed by the average-number system?
4. How is the cost of twisting determined by the average-number system?
5. How is the cost of reeling figured by the average-number system?
6. How is the cost of warping found by the average-number system?
7. How is the cost of raw cotton figured?
8. How is the total cost of making yarn obtained?

PART VI

COLLECTING AND RECORDING COST DATA

CHAPTER XXXI

INTRODUCTION TO COLLECTING AND RECORDING COST DATA

414. Cost of a Unit of Production.— A complete cost system must provide for charging the manufacturing department for each of the cost elements; material, labor, and overhead expense as explained in preceding chapters. The routine for handling stores includes a system for transferring material from the Raw Material account to the Work in Process account. The payroll analysis shows the amount of direct labor chargeable to Work in Process. The prime cost, consisting of the charges for material and labor, must be segregated by process in a process plant and by job-order numbers in a job-order factory. The analysis of expense shows how much of the overhead is applicable to each department as described in Part V. When production has been completed on the product, it is necessary to *collect the elements of cost,* in accordance with the general cost formula, and make a transfer from the Work in Process account to the Finished Goods account. A practical illustration of the work involved in collecting the elements of cost applicable to each unit of the product will help to make the problem clear.

In a phonograph-record factory the material out of which records are pressed consists of a mixture of clay and shellac. Artists are employed to sing and play so that the music may be recorded on wax discs. From these discs copper matrices are made by an electro-plating process to stamp the musical selections on the records. Royalties are paid composers for the right to use their music. The labor cost consists of the wages paid recorders, electro-platers, and record stampers. Labels have to be purchased and pasted on records. Finally envelopes must be provided in which to put the finished records. There is factory overhead expense consisting of supervision, clerk hire, rent, chemicals, and so on. Each record finished must be credited to the phonograph-record department *at cost, including* a proportion of each of the foregoing elements, and charged to Finished

Goods. The accounting system must provide the necessary mechanism for collecting data required to make the calculation of the cost of production. Without the cost system it is *impossible* to tell how much to take out of the work in process account for the records produced each period so that a transfer can be made to the finished goods account. The gathering of the elements of the cost of production and their transfer from the factory cost accounts or the Factory Cost Ledger (Form 2) to the Finished-Goods Stock Ledger (Form 3), is part of the usual routine in most cost systems.

415. Manufacturing Section of Profit and Loss Account.— Shipments of finished goods are usually made daily and, therefore, it is also necessary to provide for a transfer of the cost of finished goods sold to the Cost of Sales account. The method of procedure is to price shipments from the cost of stock records. Figuring of sales at cost provides the means of making a monthly analysis of sales, showing costs, sales, and gross profit on manufacturing.

Sales of records in a phonograph factory are priced *at cost* in order to find the cost of sales for the period. If 100 records of number 21,120 are sold for $1 each but cost 80 cents each, the calculation of the gross profit on manufacturing for that selection is an easy matter. The cost of all shipments deducted from the total sales gives the gross profit on manufacturing costs, as it is called. On the profit and loss statement the gross profit on manufacturing is carried down to the trading section.

416. Trading Section of Profit and Loss Account.— Selling expense is deducted from the gross profit on manufacturing in order to get the profit on selling. The selling expense may be prorated over the various classes of the product sold in order to find the selling profit by articles or lines of goods.

Selling expenses cover such items as advertising, catalogues, commissions, salesmen's salaries, and so on. If the gross profit of manufacturing a phonograph record is $0.20 and it costs $0.10 to sell a record, the selling profit is $0.10 each. The profit on selling is shown in the trading section of the Profit and Loss account. A company selling such different lines as phonograph records, motors, tone arms, sound boxes, and so on would have to departmentalize the selling expenses in order to calculate the relative profitableness of each class of merchandise.

417. Book Inventories.— The operation of a cost system provides for book inventory accounts. After taking out from the cost accounts the raw material used, the cost of production, and the cost of sales—the balances remaining in the Raw Material, Work in Process and Finished Goods accounts, respectively, represent the investment in inventories. The inventory balances are set up on the Balance Sheet as an asset. *Proving costs* consists in checking these book inventories with an actual count of stock, raw, in process, and finished. Unless book inventory accounts are operated on the General Ledger and checked periodically by a physical inventory, it is impossible to rely confidently on the costs. In phonograph, furniture, metallurgical, clay-products, textile, oil, and all other industries book inventory accounts should be verified at regular intervals.

418. Balance Sheet and Administrative Reports.— The operation of a system of book-inventory accounts permits the preparation of a monthly Balance Sheet as well as a Profit and Loss account. This is, of course, an important feature of a cost system. In addition to financial statements various statistical reports should be prepared for administrative purposes. The presentation of cost data by means of graphic charts offers a very attractive field for the cost accountant. By interlocking the cost and financial records a means is provided of obtaining proved costs. The proof consists in checking the book inventory accounts with a physical inventory at regular periods.

Questions on Chapter XXXI

1. What procedure is required when a unit of production is finished? Illustrate.
2. What entry is made when work is finished on the factory product?
3. How is the profit on manufacturing found?
4. Where does the profit on manufacturing appear in the Profit and Loss account?
5. What disposition is made of selling expense?
6. How are book-inventory accounts kept?
7. How is a cost system proved?
8. How can a monthly Balance Sheet be prepared?

CHAPTER XXXII

COST OF MANUFACTURE

419. Costs in Continuous-Process Plants.— In the preceding chapters the various items comprising a cost calculation were considered separately. It is now necessary to view the various elements of cost in relation to the general cost formula and the method of exercising accounting control. The methods of procedure for calculating process costs for a given period and individual-job costs will be described in detail. In a continuous-process plant making a single product it is apparent that the material, labor, and overhead expense can ordinarily be merged in one Work in Process account. If the inventory is taken at a time when there is no work in process, the calculation of the cost of production is a simple problem in arithmetic: the units of production for the period when divided into the cost for the corresponding period give the average cost per unit. Thus, in a bakery, if the cost is calculated for a period beginning with a time when there is no bread in process and ending when there is no unbaked bread, the cost per 1,000 loaves is a simple calculation, provided all the elements of cost have been entered on the Cost Sheet.

The problem, however, is not always so simple because there is usually work in process at the end of an accounting period. Take for purposes of illustration a plant producing common red brick. There may be a different quantity in process at the end of an accounting period than there was at the beginning of the period. It is obvious that the cost of production is affected by the inventory values at both the beginning and end of the accounting period. Assume that the charges to the Work in Process account for a period, including the opening inventory, are $10,000. Then suppose that at the end of the period the production records show that 900,000 bricks have been produced and that 200,000 bricks remain in process. Bricks in process are stated to be worth one-half as much as finished bricks or in other words the 200,000 bricks in process are

equivalent in point of cost to 100,000 finished bricks. Adding 100,000 bricks to the 900,000 produced, and dividing the result into $10,000 we obtain $10 per 1,000 as the cost of producing finished bricks. The bricks in process are worth only half of this figure or $5 per 1,000 at which they are valued for inventory purposes. The inventory value of the 200,000 bricks in process at the end of the accounting period has to be brought down to the next period and the finished bricks charged to the Finished Bricks account. The loss sustained on broken bricks or "bats" has to be charged to "firsts," or good bricks. This briefly is the problem of cost accounting in process factories. One who understands the method of cost accounting in a brickmaking plant can apply the same principles to the lead, oil, and other industries making the product from a single kind of raw material.

In a continuous-process plant where the product of one department becomes the raw material of the next department, it is necessary to calculate for each process separately the unit cost of the product each period. Then in order to find the total cost of production it is necessary to compute the unit costs for all the processes through which the material has passed. For example, in a steel mill where ore is converted into pig iron from which the steel ingots are made that are later rolled into rails it is seen that several distinct processes are encountered before the finished product is ready for the market. The cost calculation requires that the cost of pig iron be determined first. This becomes the raw material for the manufacture of steel ingots. The cost of making ingots must be calculated, including the cost of pig iron. Ingots are the raw material for making steel rails, the cost of which must next be computed. Inasmuch as each department producing pig iron, ingots, and steel rails carries inventories, it is essential that they be considered in making the cost calculation in just the same way as in the case of the bricks previously referred to.

In continuous-process plants, like mills where Bessemer or Open-Hearth steel products are made, it is usually the practice to refer to all direct labor and overhead at the works as conversion cost. The details of the cost problem in a steel-rolling mill producing steel rails are as follows: the cost of raw materials (iron ore, coke, and limestone) used for making pig iron, added to the conversion cost gives

the total cost of the pig-iron department for the period. The cost of the pig iron used for making steel ingots is computed in the same manner as was the cost of raw material of the bricks, and a charge made to the steel-ingot department. The cost of the pig iron is added to the conversion cost to get the total cost of the ingot department for the period. The cost of the ingots used to make rails is computed and a transfer made to the steel-rail department. The conversion cost is added to the cost of ingots to obtain the total cost of the steel-rail department for the period, and the cost of rails sold is credited to the rail department.

If a steel mill not only rolls rails but also rolls plate and structural shapes, it is necessary to treat each class of rolling-mill products separately in making the cost calculation. Each class would have its own raw material and conversion cost so that the cost per ton could be found independently for rails, structural shapes, and plate. This conversion cost represents the cost of processing the raw materials into the finished product.

What has been said about the cost calculation of the products of a steel mill applies with equal force to the products of all other continuous-process plants where the product of one department becomes the raw material of another department.

At the close of an accounting period the work in process is inventoried in the pig-iron, steel-ingot, and rail departments and is set up on the Balance Sheet. The sheets showing the cost of producing pig-iron, steel ingots, and rails should be made up from the Cost Ledger in which are entered all items pertaining to the work in process inventories, raw materials, and conversion cost.

It should be noted that in all these process-cost determinations the results are obtained only at the end of an accounting period which in most cases is a month, or four or five weeks. In a subsequent chapter a more detailed explanation will be given of the operation of the Cost Ledger in a process plant.

420. Costs in Job-Order Factories.— The methods followed in cost finding in job-order factories will be considered next. Ordinarily the issuing of a production order to the factory is a notice to the factory accountant that an account should be opened on the Cost Ledger for the job. Production orders are numbered to facilitate making charges to the proper accounts for raw material, direct labor,

and overhead expense. In the General Ledger a Work in Process account is opened but all details regarding individual jobs are entered in the Cost Ledger according to the proper job numbers. Because of the details required to be entered on each job cost sheet in the Cost Ledger, special rulings are necessary in almost every case. Usually the compilation of job costs is not a very difficult matter.

There are several sources of information regarding a job cost. First there are the raw-material stores requisitions which show the material issued against job-order numbers. These are priced and extended when entered on the issued side of the Stores Ledger. Requisitions or material reports have to be posted to the various cost sheets in the Cost Ledger, and this operation gives the cost of raw material used on the jobs.

The next step is to take the direct labor time reports or tickets showing the elapsed time spent on each job and make the necessary entries on the cost sheets in the Cost Ledger. Sometimes only the money value of the labor is shown on the cost sheets; sometimes the productive hours only are entered; and sometimes both are recorded. In certain cases machine hours are entered. The method of making the calculation of the labor cost and applying overhead expense determines how the time is to be recorded. A few examples will show the method of making a summary of a job cost.

CASE 1. COST LEDGER

Job 100

Raw material, Requisition 1 ..... $100.00

Direct labor and overhead:

Department	Labor	Overhead		Total
A	$ 20.00	50%	$10.00	$ 30.00
B	40.00	30%	12.00	52.00
C	50.00	20%	10.00	60.00
	$110.00		$32.00	$142.00

142.00

Manufacturing cost $242.00

Number of pieces made 10

Cost per piece ..... $ 24.20

Reference to the above cost calculation shows that after the material and labor have been entered, the overhead is obtained by adding

a percentage to the labor cost and the manufacturing cost is thus determined readily. This is typical of the job-order cost calculation to be found in any jobbing plant, such as a structural-iron or sheet-metal works. This method of cost calculation is also found in barrel and wooden-box factories.

If the above cost calculation had been made for a certain part, to be used for assembling into some manufactured product, and the letters A, B, and C stood for separate operations, we would have a typical cost analysis for a machine shop making a standard product. In a machine shop making standardized magnetos the method of procedure is to figure the cost of each part separately and then to calculate the cost of the assembled product. Material for the complete magneto consists of the various parts and partial assemblies or units used by the assembly foreman. To the cost of this material must be added the labor and overhead for the final assembling operation in order to get the cost of the product. If overhead is applied at an hourly rate, the cost calculation would, of course, appear as shown in the next example.

CASE 2. COST LEDGER

Job 200

Raw material, Requisitions 2 and 3 ..... $200.00
Direct labor and overhead:

Department	Labor	Hours	Overhead		Total
A	$25.00	50	$0.20 hr.	$10.00	$ 35.00
B	30.00	20	0.25 "	5.00	35.00
C	40.00	60	0.30 "	18.00	58.00
	$95.00			$33.00	$128.00

$128.00

Manufacturing cost $328.00

Number of pieces made 10
Cost per piece ..... $ 32.80

From the foregoing it will be seen that the cost calculation in the second case requires the entry of the direct labor hours from the time reports in order that the overhead may be extended at the proper hourly rates. After that is done the manufacturing cost can be computed easily. This cost calculation is typical of what is found in

specialized industries such as those making X-ray machines, electrical devices, and mechanical goods.

CASE 3A. COST LEDGER

Job 300

Raw material, Requisitions 7, 8, 11, 20 ..... $400.00
Direct labor:
Department A $45.00
Department B 50.00
Department C 25.00 $120.00

Prime cost $520.00
Overhead 50 per cent 260.00

Manufacturing cost $780.00

Number of pieces made 10
Cost per piece ..... $ 78.00

CASE 3B. COST LEDGER

Job 400

Raw material, Requisitions 7, 8, 11, 20 ..... $400.00
Overhead on material 10 per cent 40.00

$440.00

Direct labor and overhead:

Department	Labor	Overhead		Total
A	$ 45.00	30%	$13.50	$ 58.50
B	50.00	40%	20.00	70.00
C	25.00	20%	5.00	30.00
	$120.00		$38.50	$158.50

$158.50

Manufacturing cost $598.50

Number of pieces made 10
Cost per piece ..... $ 59.85

The foregoing cost calculations illustrate the principle of applying overhead partly on material and partly on labor. Under Case 3A a blanket percentage of 50 was added to the prime cost. This method of calculation is typical of the cut-stone and marble-contracting business because of the bulky character of the material used. In 3B a different percentage from that used for the overhead in each of the operating departments was used for material overhead. This is a

necessary procedure in many plants in order to make an equitable apportionment of overhead expense. Sometimes the overhead on material is on a tonnage basis. In an iron foundry the expenses of handling pig iron and coke and running the cupola are prorated on a tonnage basis over the metal castings, while the overhead incurred in making cores and molds is distributed as a burden on direct labor.

CASE 4. COST LEDGER

Job 500

Raw material, Requisitions 22 and 25	$100.00
Overhead on material, 10 per cent	10.00
	$110.00

Direct labor and overhead:

Department	Hours	Rate	Total
A	20	$0.50 hr.	$10.00
B	30	0.75 "	22.50
C	50	1.00 "	50.00
			$ 82.50

Manufacturing cost	$192.50
Number of pieces made	10
Cost per piece	$ 19.25

This form of cost calculation shows the method of applying overhead and labor by the "sold-hours" plan. The rate per hour covers both labor and overhead for each department and the rates constitute a service charge for each department. This cost calculation illustrates the plan followed in automatic-machine departments, printing, lithographic, paper box and similar industries. The hourly departmental rates, including direct labor, are used not only to make the cost calculation after the jobs have been finished but also to estimate new work.

Case 5 illustrates the calculation of a job cost under the process-center method when each class of machine or production unit used carries a separate overhead rate. This is the method recommended by the Association of Textile Finishers. The system is found in some of the largest textile finishing plants as well as in highly organized machine shops.

CASE 5. COST LEDGER

Job 600

Material, Requisition 30	$400.00
Overhead on material, 12½ per cent	50.00
	$450.00

Direct labor and overhead:

Department	Labor	Overhead: Machine Hours	Overhead: Class	Overhead: Amount		Total Labor and Overhead	
A	$ 40.00	30	ML	$0.40 hr.	$12.00	$ 52.00	
B	50.00	60	MS	0.50 "	30.00	80.00	
C	30.00	40	MP	0.75 "	30.00	60.00	
	$120.00				$72.00	$192.00	
							$192.00

Manufacturing cost	$642.00
Number of pieces made	10
Cost per piece	$ 64.20

An effort has been made to show how the cost calculation appears on the cost sheets in the Cost Ledger under various methods of apportioning overhead expense. After the cost has been figured the cost sheet is removed from the current binder and filed in a binder containing only sheets for completed jobs. A record has to be kept of the cost of jobs finished each period so that an entry can be made crediting Work in Process. The file of uncompleted cost sheets represents the inventory of work in process. When jobs are in process of manufacture at the time of closing a set of books, it is obviously necessary to provide some means for ascertaining the cost to date. A marble stairway for a State Capitol building may be in process for a period of two years so that each time the books are closed during this period the cost to date on the job must be shown. Details of the Work in Process account can be ascertained at any time by referring to the individual sheets in the Cost Ledger.

421. Work in Process Controlling Account — Job-Order Cost System.— In a job-order cost system it is customary to open a Work in Process controlling account. Every item chargeable to an individual job must be included in the charges to the Work in Process

controlling account. When a job is finished, the cost is figured and the cost sheet transferred from the current file to the file for completed jobs. The total cost of the jobs finished during each period must be credited to Work in Process, as indicated in the following *pro forma* account:

Dr. WORK IN PROCESS *Cr.*

1	Inventory of jobs in process at beginning of period.	XX	31	Cost of jobs finished during the period,	XX
31	Raw material and parts issued from stores,	XX		Balance, inventory of jobs in process at close of period	XX
	Productive labor charged directly to jobs,	XX			
	Overhead expense applied as a burden on jobs,	XX			
	Dept. A. X				
	Dept. B. X				
	Dept. C. X				
		XX			XX
1	Balance, brought down	XX			

The Work in Process controlling account is opened with an inventory of the jobs in process and is charged, as shown, with stores issues, direct labor, and overhead expense applied as a burden on jobs. As previously stated the amount of the overhead expense to be charged depends upon the rates used for applying burden and the number of units on the basis of which expense is apportioned. When jobs are finished, the cost is computed and the controlling account credited, as shown, with those completed during the period. It is thus evident that the balance remaining in the account at the end of an accounting period must represent the inventory of unfinished jobs in the factory. The accuracy of the book balance can be proved by comparing it with the aggregate of the cost sheets in the subsidiary Ledger after all the job sheets have been posted up to date and the burden added. Ordinarily this is done only at inventory time.

422. Departmental Process Controlling Account — Process Cost System.— It is customary in continuous-process factories to open Departmental Process controlling accounts corresponding to the different processes carried on. This is equivalent to subdividing the Work in Process account in a job-order cost system. The following

pro forma account will illustrate the method of handling a typical operating department process account.

Dr. DEPARTMENT A — WORK IN PROCESS *Cr.*

1	Inventory at beginning of period	XX	31	Production of finished goods	XX
31	Superintendence	XX		Balance, inventory at close of period	XX
	Operating labor	XX			
	Operating supplies	XX			
	Repair labor	XX			
	Repair material	XX			
	Fuel	XX			
	Power purchased	XX			
	Insurance	XX			
	Taxes	XX			
	Depreciation	XX			
		XX			XX
1	Balance, brought down	XX			

Direct charges are made to the Departmental Process controlling account, as shown. The principal point of difference between the method of handling this account and the Work in Process controlling account previously explained (used in a job-order cost system) lies in the manner of making the credit entry. At the close of a period the debit side shows the total cost chargeable to the product, a part of which has been finished and transferred to another department, and a part of which remains unfinished. It is necessary to apportion the total of the charges between the finished and the unfinished product. If the process was quarrying granite rock the procedure would be as follows:

Suppose that the total charges for the period amounted to $100,000 and that the product shipped was 150,000 tons and the unshipped rock 50,000 tons. Then the average cost of the process per ton would be equal to $100,000 ÷ 200,000 tons which gives $0.50 per ton. In making the closing entries the first step is to make a credit entry covering the cost of the product which was shipped. This amounts to $75,000 after which the inventory of $25,000 is brought down to open the account for the next period.

The method of calculating the process cost per unit of the product is not always as simple as in the case just given. An example taken from another industry will make the problem involved in computing

the unit cost of a process clearer. Take, for example, the burning process in a plant making clay tile. Suppose, for example, that the total charges for the period against the burning process were $550. During the period 400,000 tiles were completely burned and transferred to the next process. It is stated by the burning-department foreman that there remain in process 200,000 which are three-fourths burned on an average. This amount of process effort is equivalent to that required to finish completely 150,000 tiles. The tiles fully burned added to the 150,000 give 550,000 tiles to be divided into $550, the cost of burning for the period, which gives $1 per 1,000 as the cost of burning tiles.

In closing the Burning-Department Process account the first step is to credit the account for the production of completely burned tiles which is ($1 × 400) $400 and to bring the inventory of ($0.75 × 200) $150 down to open the account for the next period.

There are, of course, cases where neither of the foregoing methods can be employed for closing a department process account at the end of an accounting period. It may be necessary to estimate the inventory value of the unfinished work in process and use the figure to close the Department Process account. The difference between the inventory value at the end of a period, and the total charges to the account during the period, gives the amount to assess the product from a particular process.

423. Finished Goods Controlling Account.— When the product of the factory is completed, it is quite customary to charge it to a Finished Goods Controlling account. The operation of the account is not unlike that of a Raw Material account except that the entries come from different sources. The transfer of the manufactured product from Work in Process to Finished Goods takes the product out of the manufacturing section of the cost accounts and puts it into the trading section. From now on the transactions are recorded just the same as in any merchandising enterprise.

In some plants jobs are shipped directly from the manufacturing department to the customer. This is especially true in contract work. When this condition prevails it is the practice to credit finished jobs to the Work in Process account at cost and charge them directly to the Cost of Sales account. Under this state of affairs the Finished Goods account is dispensed with.

When partial shipments are made from an order in process, the question naturally arises what is the best means for crediting the Work in Process account inasmuch as the cost of the job has not been calculated. The only expedient to meet this condition seems to be to estimate the cost of the articles shipped and then to make an adjustment when the job is completed in case the estimate did not coincide with the cost.

The following *pro forma* account will make the method of procedure clear.

Dr. FINISHED GOODS *Cr.*

1	Inventory at beginning of period	XX	31	Goods sold customers	XX
31	Finished goods produced in the factory	XX		Balance, inventory of finished goods at end of period	XX
	Goods returned by customers	XX			
		XX			XX
1	Balance, brought down	XX			

It will be seen from the foregoing illustration that the Finished Goods account as operated shows the inventory of merchandise on hand at the end of each accounting period. When the factory product is finished, it is charged to this account at the cost price. Any goods returned by customers are also charged to the account. Goods sold customers are priced at cost and a credit entry made as indicated. The balance to the Finished Goods account is set up as an asset under the head of inventories on the Balance Sheet. At the close of an accounting period the inventory of finished stock should be reconciled with the balance to the Finished Goods controlling account and any necessary adjustments made.

Selling Expense.— So far no mention has been made in this chapter of selling or commercial expense. Selling expense is kept separate from factory overhead and closed out to Profit and Loss. In a large trading enterprise like a department store the selling expenses are, of course, kept in several accounts corresponding to the various departments of the business. Selling expense is usually distributed on a *pro rata* basis over the various items of sales in a department on the ground that the selling effort in a department

varies in direct proportion to the selling price of the various commodities.

424. Summary.— The bringing together of the various elements of cost is usually accomplished on a cost summary sheet. In a process plant one would expect to find a summary of cost at the end of each period showing the unit cost of each class of articles produced. In a job-order plant a separate job-cost sheet is used to keep an account with each job. The main point of difference between one job-cost system and another is the method used in applying overhead expense. Selling expense is not added directly to the cost of the product but is closed out to Profit and Loss each period.

Questions on Chapter XXXII

1. When are costs figured in continuous-process plants?
2. When are costs figured in job-order factories?
3. How is the overhead expense ordinarily handled in continuous-process plants?
4. In case the product of one department becomes the raw material of the next department, how is the cost calculation affected? Give an example.
5. What procedure is followed in calculating costs in cotton-yarn spinning mills?
6. What relation do the production orders bear to the cost system in a job-order factory?
7. From what sources does the information come for figuring job costs?
8. Give an example of how a job cost is figured when overhead expense is applied as a percentage on direct labor.
9. Give an example showing how overhead is applied as a burden by means of an hourly rate.
10. How is overhead applied as a percentage on prime cost?
11. How is overhead applied partly on material, and partly on productive labor?
12. Give an example showing how a job cost is figured according to the sold-hours method.
13. Give an example showing how a job cost is figured according to the machine-hours method.
14. Suggest a plan for distributing the overhead expense of a public storage warehouse as a means for establishing rates for service. The service rendered by the warehouse consists of handling incoming and outgoing packages and in storing them.

CHAPTER XXXIII

ANALYSIS OF SALES

425. Cost of Sales.— It is necessary to provide some means of making an analysis of the sales for each period. The purpose of making the analysis is to show which departments, lines of merchandise, or jobs are the most profitable. When a sale takes place two transactions have to be recorded. The first consists in crediting the merchandise sold to the Finished Goods account and in making a charge to the Cost of Sales account. There are, of course, cases of a manufacturer having no finished goods on hand, such as jobs for the manufacture and installation of ornamental bronze work in banks. Here the cost of the finished job is credited to the Work in Process account and charged directly to the Cost of Sales account. Under such a condition the Finished Goods account is dispensed with. The second transaction consists in billing the customer for the merchandise at the selling price, the Sales account being credited and Accounts Receivable charged. If a customer returns merchandise for credit, it is necessary to reverse the foregoing entries.

426. Gross Profit.— The difference between the gross sales and the return sales for a period gives the net sales. The cost of gross sales less the cost of return sales gives the net cost of sales for the period. Gross profit for the period can then be obtained by deducting the net cost of sales from the net sales. Ledger entries in the following *pro forma* accounts indicate how the Cost of Sales and Sales accounts appear on the General Ledger.

Dr. Cost of Sales *Cr.*

31	Cost of merchandise sold customers	XX	31	Cost of merchandise returned from customers	XX
			31	Profit and Loss	XX
		XX			XX

Dr.					Sales		Cr.
31	Merchandise returned from customers	XX		31	Merchandise sold to customers		XX
31	Profit and loss	XX					
		XX					XX

If the price at which merchandise is sold is greater than its cost the net result is a gross profit on sales. It will be seen that both the foregoing accounts are closed out to Profit and Loss. It is desirable that the sales and cost of sales be kept in separate accounts in order to furnish a convenient means of analyzing the sales into the two parts, cost and profit. The purpose of analysis, as previously mentioned, is to show which departments, lines of commodities, or jobs are profitable. When this information is made available, the management knows which goods need pushing. It is not uncommon to find a business enterprise carrying along a department which is continually losing money. It is not until after the business is completely departmentalized that departments selling at a loss can be brought to attention.

427. **Billing and Charge System.**— It is a rule in every well organized plant that no goods shall be shipped unless charged up to some customer's account. In order that the accounts with customers may be kept correctly and no omissions made it is the usual practice to put in operation a complete system for making out bills and charging goods shipped to customers. Thus, in a straw-hat factory the order must show the quantity of hats wanted of each size, the plait to be used, the block number, height of crown, width of brim, how trimmed, and so on. These shipping orders are generally made in manifold so that copies will be available for office use as well as for the shipping clerk. It is ordinarily from the office copy of the shipping order that factory production orders are made out. When a shipment is made in part or completely it is the duty of the shipping clerk to check the items shipped on his copy of the shipping order. After shipment has been made the shipping clerk sends his copy of the order into the office so that invoices to the customer can be typewritten. The cycle of operations from the making out of the shipping order to the billing and analysis of sales will be explained in detail.

428. **Shipping Order.**— The transactions pertaining to the sale of goods to a customer may be said to begin with the making out of the shipping order. It is important that all specifications regarding goods to be shipped to a customer be entered on the order blank. The steps taken are as follows:

When a customer's order is received either from one of the traveling salesmen, or in the mail, it is necessary to make out a shipping order. This is usually done on a special form which is designed to contain all specifications of the goods wanted.

429. **Invoice Forms.**— It is the customary practice to use invoices such as shown in Form 97 in making out the customer's bills.

Terms	" Invoice The Southern Mills Corp'n. Sold to	No. Date

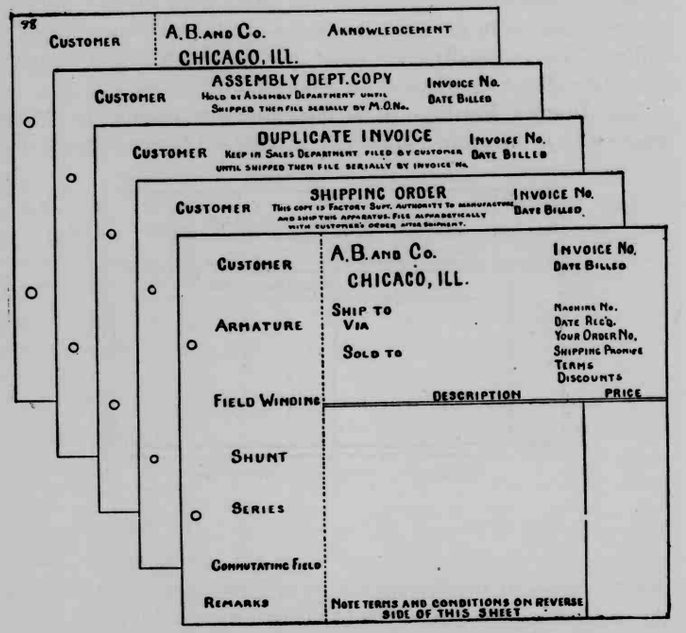
	Style	Quantity	Unit	Price	Amount	Total

Form 97. Invoice to Customer

The name and address of the customer, quantity, description, and amount of goods sold, terms, and so on are entered on the invoice. Several copies of the invoice are usually prepared, so that enough copies are available to send one to the customer, to keep one for the use of the bookkeeper as a posting medium in making a charge to the customer's account, and to leave another for the collection clerk's use in following up overdue accounts. As soon as the invoices have been typewritten the billing clerk should make an entry in the upper right-hand corner of the shipping order headed "memorandum" showing the goods billed. This information is needed for reference if the question is raised whether or not all of the goods on the shipping order have been billed to the customer.

430. **Manifold Order System.**— It is quite a common practice to make use of a manifold order system to provide copies to be used

for the customer's invoice, acknowledgment to customer, and also copies for the shipping, sales, and assembly departments. The manifold order system presented in Forms 98 to 98D, inclusive, is used by a manufacturer of electrical goods. The first or "Invoice" copy is to be used for the invoice to the customer. The second copy,

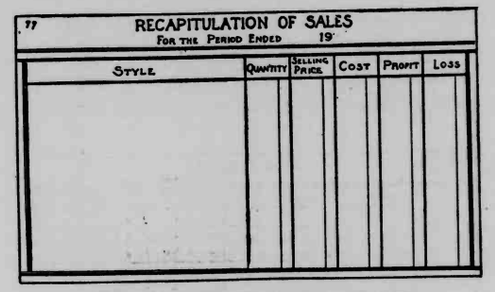

98
CUSTOMER
A.B. AND CO.
CHICAGO, ILL.
ACKNOWLEDGEMENT
ASSEMBLY DEPT. COPY
HOLD BY ASSEMBLY DEPARTMENT UNTIL SHIPPED THEN FILE SERIALLY BY M.O.No.
INVOICE No.
DATE BILLED
DUPLICATE INVOICE
KEEP IN SALES DEPARTMENT FILED BY CUSTOMER UNTIL SHIPPED THEN FILE SERIALLY BY INVOICE No.
SHIPPING ORDER
THIS COPY IS FACTORY SUPT. AUTHORITY TO MANUFACTURE AND SHIP THIS APPARATUS. FILE ALPHABETICALLY WITH CUSTOMER'S ORDER AFTER SHIPMENT.
ARMATURE
FIELD WINDING
SHUNT
SERIES
COMMUTATING FIELD
REMARKS
SHIP TO
VIA
SOLD TO
MACHINE No.
DATE REC'D.
YOUR ORDER No.
SHIPPING PROMISE
TERMS
DISCOUNTS
DESCRIPTION
PRICE
NOTE TERMS AND CONDITIONS ON REVERSE SIDE OF THIS SHEET

FORM 98. MANIFOLD ORDER

known as the "Shipping Order," is the factory's authority for manufacturing and shipping the goods ordered. The third copy, headed "Duplicate Invoice," is held in the sales department. The fourth copy of the order goes to the assembly department. The last copy is to be used as the acknowledgment of the order sent the customer. The use of a manifold order system such as this is a great time saver because all five copies of the order are typewritten at the same time by the use of carbons. The system is adapted to a wide range of

business enterprises in which several copies of the customer's order are required.

431. **Customer's Ledger.**— For the purpose of keeping the accounts with customers a two-column form, which may or may not have a balance column, is usually used. It is to these cards that charges for all goods shipped are posted. All remittances from customers are entered in the credit column of the cards. The use of a card form for the Customer's Ledger is preferred by many accountants to the loose-leaf system. One of the main reasons for this is that the cards when properly arranged behind guide cards are more quickly found when wanted than loose-leaf sheets in a binder. Another argument in favor of cards is that after posting they can be


77
RECAPITULATION OF SALES
FOR THE PERIOD ENDED 19

STYLE	QUANTITY	SELLING PRICE	COST	PROFIT	LOSS

FORM 99. RECAPITULATION OF SALES

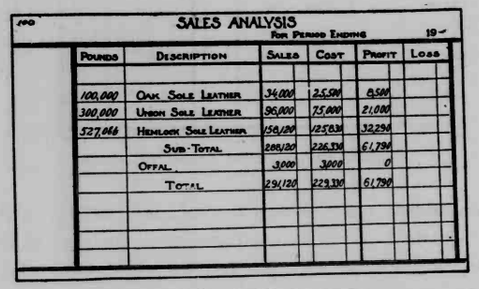
taken to an adding machine and a total made of the entries for the day, after which they can be compared with footings of the sales on cash books, as the case may be, and the correctness of the entries proved. If the charges check with the footing of the Sales Book and the credits with the footing of the "Accounts Receivable" column in the Cash Book, the cards can then be returned to their places in the file. Furthermore, the use of this system makes it an easy matter to transfer inactive accounts to a separate file, leaving only the active accounts to be handled.

432. **Sales Book.**— The copy of the invoice used for a posting medium constitutes the Sales Book, and it is from a summary of these duplicate invoices that the total sales for a period are obtained. There are various ways of analyzing the sales into departments, lines

of goods sold, and so on. Thus, in a jewelry factory producing several lines of goods known as the college line, souvenir goods, badges, and novelty goods, it is necessary to provide for segregating the sales according to these lines. In case it is desired to obtain an analysis of sales in great detail, as when a large number of lines are handled, it is often desirable to introduce some mechanical means for making the analysis, such as automatic sorting and tabulating machines, which will be explained in a subsequent chapter.

433. Recapitulation of Sales.— It is also necessary to analyze the cost of sales as well as the sales according to departments, lines of goods, and so on. After this has been done a recapitulation of sales can be made on a sheet such as shown in Form 99. In this way the sales and cost of sales for various articles sold in any department can be brought together. This is a very good plan for statistical purposes.

434. Sales Analysis.— If a company only deals in a few main classes of goods, a sales analysis such as shown in Form 100 should



100 SALES ANALYSIS

For Period Ending 19—

Pounds	Description	Sales	Cost	Profit	Loss
100,000	Oak Sole Leather	34,000	25,500	8,500	
300,000	Union Sole Leather	96,000	75,000	21,000	
527,046	Hemlock Sole Leather	158,120	125,830	32,290	
	Sub-Total	288,120	226,330	61,790	
	Offal	3,000	3,000	0	
	Total	291,120	229,330	61,790	

Form 100. SALES ANALYSIS

be prepared. The one illustrated is taken from the records of a sole-leather tannery.

435. Summary.— From the foregoing description of the forms and methods used in analyzing sales into cost and gross profit it is seen that there is much work of a routine nature involved. The breaking up of sales into the elements of cost and profit is a necessary part of the procedure where a system of costs and monthly financial statements is in operation.

Questions on Chapter XXXIII

1. What two transactions take place when a sale is made?
2. What is meant by making an analysis of sales? Give an example.
3. What is gross profit? How is it calculated?
4. How are the Cost of Sales and Sales accounts kept?
5. What is meant by a billing and charge system? Give an example.
6. What purpose is served by a shipping order?
7. How are invoice forms used?
8. How is the Customer's Ledger operated and controlled?
9. What is meant by the Sales Book?
10. A jobber of piece goods purchased the following woolens from the X-Mill Co.: Piece 100, 50 yds., @ $2.10; Piece 101, 47 yds., @ $2.20; Piece 102, 51⅛ yds., @ $3.00; Piece 103, 48⅞ yds., @ $2.50; Piece 104, 50⅞ yds., @ $2.65; Piece 105, 52⅛ yds., @ $2.40; Piece 106, 51 yds., @ $2.35; Piece 107, 50⅞ yds., @ $2.00. These goods were priced to sell at 50 per cent above cost. The following pieces were sold: 101, 103, 105, and 107.

    Show how the entries would appear in the Sales and Cost of Sales accounts. What was the jobber's gross profit on sales?
11. From the following data make a calculation showing the cost per hundredweight of producing milk:

    The following expenses were incurred: interest, $53,071; taxes, $1,558; insurance, $1,971; depreciation, $273; purchases, $76,007; labor, $146,789; and farm products used for stock, $411,117.

    There are the following offsets to expenses: increase in value of buildings, $24,977; increase in value of cattle, $2,586; sales of cattle, $32,371; butter used in house, $78; milk used in house, $72.68; milk fed stock, $300; manure, $47,936; hides, $3,925; breeding fees, $15.

    There were produced 240,000 cwt. of raw milk.

CHAPTER XXXIV

SUBSIDIARY FACTORY LEDGER

436. Factory-Ledger Control.— When a number of manufacturing plants are operated by one company, it is usually found desirable to take the cost accounts out of the General Ledger and put them in a separate ledger. Sometimes when a factory is located away from the main office, it is also desirable to remove the cost accounts from the General Ledger and keep them in the Factory Ledger. This procedure simplifies the taking off of a trial balance from the General Ledger. However, if the cost accounts are removed from the General Ledger, it is necessary to replace them with some other account or accounts.

The proper method of procedure, where the cost accounts for one factory have been removed, is to put an account in the General Ledger called "Factory Ledger" in order to make the General Ledger balance. It is also necessary to put an account in the Factory Ledger called "General Ledger" to make the Factory Ledger balance. By this means both the General Ledger and Factory Ledger are rendered self-balancing.

437. Trial Balance.— When a trial balance is taken off from the General Ledger, it will be found that the Factory Ledger account has a debit balance, and when a trial balance is taken off from the Factory Ledger, it will be found that the General Ledger account has a credit balance. The amount of the balances to the Factory Ledger account in the General Ledger and the General Ledger account in the Factory Ledger should be the same at the end of an accounting period.

The trial balance taken from the General Ledger can be combined with the one taken from the Factory Ledger by eliminating the Factory Ledger and General Ledger accounts since the accounts appear on opposite sides of the respective trial balances, the former having a debit balance, and the latter a credit balance. The relation of the trial balance taken from the General Ledger to that taken from the

Factory Ledger will be readily understood from the following *pro forma* case:

TRIAL BALANCE TAKEN FROM GENERAL LEDGER AS OF DECEMBER 31, 19—

	Dr.	*Cr.*
Factory Ledger	XX	
Cash	XX	
Accounts Receivable	XX	
Notes Receivable	XX	
Prepaid Charges	XX	
Plant	XX	
General Expense	XX	
Cost of Sales		XX
Accounts Payable		XX
Notes Payable		XX
Taxes Accrued		XX
Reserve for Depreciation		XX
Capital		XX
Surplus		XX
Sales		
Total	XX	XX

TRIAL BALANCE TAKEN FROM FACTORY LEDGER AS OF DECEMBER 31, 19—

	Dr.	*Cr.*
General Ledger	XX	XX
Raw Material	XX	
Supplies	XX	
Work in Process	XX	
Finished Goods	XX	
Factory Overhead Expense	XX	
Payroll	XX	
Total	XX	XX

It will be seen that in the following consolidated trial balance the balances to the Factory Ledger and General Ledger accounts have been dropped out. The method followed in preparing a Balance Sheet and a Profit and Loss account where the Factory Ledger is separated from the General Ledger is the same as when all of the accounts are kept on one Ledger.

CONSOLIDATED TRIAL BALANCE AS OF DECEMBER 31, 19—

	Dr.	Cr.
Cash	XX	
Accounts Receivable	XX	
Notes Receivable	XX	
Inventories:		
Raw Material	XX	
Supplies	XX	
Work in Process	XX	
Finished Goods	XX	
Prepaid Charges	XX	
Plant	XX	
General Expense	XX	
Cost of Sales	XX	
Factory Overhead Expense	XX	
Payroll	XX	
Accounts Payable		XX
Notes Payable		XX
Taxes Accrued		XX
Reserve for Depreciation		XX
Capital		XX
Surplus		XX
Sales		XX
Total	XX	XX

438. Journal Entries.— The method of journalizing transactions that affect the cost accounts will be considered now. A good place to begin is with the procedure for handling purchases on the General Ledger. It must be remembered that raw material is a Factory Ledger account. The entry in the General Ledger when a purchase is made is as follows:

Dr.	Factory Ledger	XX	
Cr.	Accounts Payable		XX

It is necessary to make a collateral entry on the Factory Ledger for the purchase as follows:

Dr.	Raw Material	XX	
Cr.	General Ledger		XX

439. Pro Forma Ledger Accounts.— The *pro forma* Ledger accounts opened by these entries appear as follows:

General Ledger Accounts

Dr.	FACTORY LEDGER		*Cr.*
31 | Purchases	| XX ||	|	|

Dr.	ACCOUNTS PAYABLE		*Cr.*
|	|	|| 31 | Factory Ledger	| XX

Factory Ledger Accounts

Dr.	RAW MATERAL		*Cr.*
31 | General Ledger	| XX ||	|	|

Dr.	GENERAL LEDGER		*Cr.*
|	|	|| 31 | Raw Material	| XX

A similar method of procedure is followed when disbursements are made on account of payrolls, and whenever the General Ledger pays out money or assumes an obligation for the factory.

When shipments of finished goods are made, it is necessary to make entries on the General Ledger and also on the Factory Ledger. The entry would be as follows on the General Ledger:

Dr.	Cost of Sales	XX	
Cr.	Factory Ledger		XX

The entry on the Factory Ledger is as follows:

Dr.	General Ledger	XX	
Cr.	Finished Goods		XX

After these entries have been posted the *pro forma* ledger accounts will appear as follows:

General Ledger Accounts

Dr.	COST OF SALES		*Cr.*
31 | Factory Ledger	| XX ||	|	|

Dr.	FACTORY LEDGER		*Cr.*
31 | Purchases	| XX ||	| Cost of Sales	| XX

Factory Ledger Accounts

Dr.	General Ledger		*Cr.*
31 | Finished Goods	| XX || 31 | Raw Material		| XX

Dr.	Finished Goods		*Cr.*
|	| || 31 | General Ledger		| XX

440. **Internal Factory Transactions.**— For all internal factory transactions the entries are made without regard to the General Ledger controlling account. For example, when raw material is issued to the manufacturing departments, the entry on the Factory Journal is as follows:

Dr. Work in Process	XX	
Cr. Raw Material		XX

The same principle holds in regard to other internal transactions. From this explanation no one should experience any difficulty in handling a Factory Ledger separately from the General Ledger.

441. **Summary.**— The most common conditions under which a Factory Ledger is operated independently of the General Ledger are in plants removed from the main office. This is because it is difficult to get the main-office accountant to make the proper entries to the factory cost accounts. So the expedient is adopted of having the head accountant charge all items pertaining to the Factory Ledger account, leaving it to the cost accountant at the works to make such distributions as he deems necessary. By this means responsibility is divided up for keeping the commercial accounts on the one hand and the factory or cost accounts on the other. Also, when there are a great many plants operated by one company, it simplifies the taking off of the General-Ledger trial balance if the cost accounts are kept in separate Factory Ledgers. Then one account only need be kept with each plant in the General Ledger. Companies operating a number of plants making white lead, linseed oil, and petroleum products usually operate Factory Ledgers separately from the General Ledger.

Questions on Chapter XXXIV

1. What is the purpose of a subsidiary Factory Ledger? How is it operated? Give an example.

2. How is the Factory Ledger reconciled with the General Ledger? What accounts are opened in each for the purpose of effecting the reconciliation?
3. In case a Factory Ledger is put into operation, what procedure is followed in making Journal entries for an item such as purchases?
4. Illustrate how the *pro forma* Ledger accounts would appear after entries for purchases have been posted.
5. Do internal factory transactions affect the General Ledger where a Factory Ledger is kept?

CHAPTER XXXV

FINANCIAL STATEMENTS

442. Relation of Cost System to Financial Statements.— The operation of a cost system provides a means of preparing a correct Balance Sheet and Profit and Loss account at the end of each accounting period. The previous explanation of controlling accounts showed how the inventory accounts are kept so that at the end of each period they show the amount invested in raw material, work in process, and finished goods. The chapter on the analysis of sales showed how the gross profit on sales is found. It now remains to show how the cost accounts are incorporated into the general financial statements of the business.

443. Trial Balance.— The best place to begin the description of the method of preparing the Balance Sheet and Profit and Loss account is the trial balance. When the bookkeeper takes a trial balance off from the General Ledger all the balances to the various accounts on the Ledger are set forth on the trial balance. There are many accounts which have not thus far been mentioned because the cost accountant is not concerned with them. Information concerning Cash, Accounts Receivable, Accounts Payable, and various other accounts which is not needed for cost purposes appears on the trial balance. On the trial balance the accounts are usually arranged in the order in which they are kept in the General Ledger. It therefore follows that it is a good practice to arrange the accounts as nearly as possible in the order in which they are set up on the Balance Sheet and Profit and Loss account.

Accountants generally agree that the best general arrangement is as follows:

Assets
Liabilities
Profit and loss accounts
Clearing accounts

If this method is followed the asset and liability accounts come together ready for the setting up of the Balance Sheet, and the other accounts are ready for the making of the Profit and Loss account. Clearing accounts, as the name indicates, do not ordinarily have a balance at the close of a period.

444. Balance Sheet.— The next matter for consideration is the order in which the asset and liability accounts should be arranged on the Balance Sheet. The question to be decided is whether the assets should begin with the cash or the investment in the plant, and on the liability side whether to begin with the current liabilities or the capital account. Sometimes one method is followed and sometimes the other, depending on the type of business. Thus, in any one of the extractive industries where the investments in the mining properties or quarries are extensive and relatively much greater than the current assets, it is the best practice to set up the Balance Sheet with the plant investment as the first item on the asset side, and the capital as the first item on the liability side. In any one of the light manufacturing industries it is the best practice to reverse the above procedure and to set up the cash on hand as the first item on the asset side and the current liabilities as the first item on the other side. Each business must be considered separately in order to determine which method is best adapted to meet its individual needs, because only general rules can be given.

There are, of course, the merits of the various forms of Balance Sheets to consider. By this is meant that the accountant has a choice between the statement or account form on the one hand and the report form on the other. The former contains the assets on the left-hand side and the liabilities on the right-hand side, while the latter form contains the assets in the upper part and the liabilities in the lower part. The advantage of the report form consists in the greater convenience in setting up the statement when it is desired not to exceed the width of an ordinary sheet of paper or to arrange the Balance Sheet for publication in a single column in a newspaper. It is generally advisable to make a Balance Sheet in such a way that the present condition of the business can be compared with the condition for a prior period.

445. Profit and Loss Account.— When it comes to the preparation of a Profit and Loss account two general plans are followed.

The first one consists of setting up the account in statement or account form. In this form it is usual to show what is called the manufacturing section, trading section, and finally, a profit and loss section. The gross profit on manufacturing is brought down to the trading section, and the gross profit on trading brought down to the profit and loss section. Finally the net profits for the period are shown. In a Profit and Loss statement this information is given in debit and credit form as if the statement were an exact copy of the Profit and Loss account on the Ledger.

In the report form the statement runs along much as one would write out a statement so that it can be easily read and understood by one who does not understand the meaning of debits and credits. The profit and loss statement should show the gross profit on manufacturing, gross profit on trading, and also the net result of the operations for the period. The results shown are, of course, the same in either case.

The statement or account forms for presenting Balance Sheets and Profit and Loss accounts are more technical than the report forms. A person must be accustomed to seeing facts presented in debit and credit form in order to readily comprehend the results set up in statement form. The report form is best suited to meet the needs of those persons who do not understand bookkeeping methods. The bank Balance Sheets which are published in daily newspapers as a means of giving publicity to the substantial character of a bank's resources are frequently in report form so that they will be easily understood. Before the accountant can decide what form to use for preparing financial reports he must consider his client's ability to understand technical statements.

The following *pro forma* statements will illustrate the different methods of making reports according to both the account and report forms. An eight-column trial balance and working sheet will furnish a good starting point when making up financial statements. The company taken for illustration is supposed to be one engaged in mining iron ore and coal and in manufacturing iron and steel products, so that the company has a large investment in property.

BALANCE SHEET WORKING FORM

Account	Trial Balance		Adjustments		Profit and Loss		Balance Sheet	
	Debits	Credits	Debits	Credits	Debits	Credits	Assets	Liabilities

It is an easy matter to prepare a Balance Sheet from the foregoing form when it is properly filled in. Both the account form and report form will be presented.

446. Balance Sheet, Account Form.

BALANCE SHEET OF THE A B C CO.

AS AT THE CLOSE OF BUSINESS, DECEMBER 31, 19—

Assets			*Liabilities*		
	XX		Capital Stock:		
Property:			.....	XX	
.....	XX		.....	XX	XX
.....	XX	XX			
Deferred Charges to Operations:			Bonded Debt:		
.....	XX		.....	XX	
.....	XX		.....	XX	XX
.....	XX	XX			
Investments:			Mortgages		XX
.....	XX				
.....	XX				
.....	XX	XX			
Sinking and Reserve Fund Assets:			Sinking and Reserve Funds:		
.....	XX		.....	XX	
.....	XX	XX	.....	XX	XX
Current Assets:			Current Liabilities:		
.....	XX		.....	XX	
.....	XX		.....	XX	
.....	XX		.....	XX	XX
.....	XX	XX			
			Surplus		XX
Total		XX	Total		XX

447. Balance Sheet, Report Form.

BALANCE SHEET OF THE A B C Co.

AS AT THE CLOSE OF BUSINESS, DECEMBER 31, 19—

	1919	1918
Assets		
Current Assets:		
Cash	XX	XX
Accounts Receivable		
Less Reserve for Bad Debts	XX	XX
	XX	XX
Inventories:		
Raw Materials	XX	XX
Work in Process	XX	XX
Finished Goods	XX	XX
	XX	XX
Plant:		
Land	XX	XX
Buildings	XX	XX
Machinery and Equipment	XX	XX
	XX	XX
Less Reserve for Depreciation	XX	XX
	XX	XX
Prepaid Charges:		
Prepaid Insurance	XX	XX
Prepaid Taxes	XX	XX
	XX	XX
Total Assets	XX	XX
Liabilities		
Current Liabilities:		
Accounts Payable	XX	XX
Capital Liabilities:		
Capital Stock	XX	XX
Surplus:	XX	XX
Profit for Month	XX	XX
Total Liabilities	XX	XX

448. Profit and Loss Account, Account Form.

PROFIT AND LOSS ACCOUNT OF THE A B C Co.
FOR THE YEAR ENDED DECEMBER 31, 19—

Inventory at beginning of period	XX	Net Sales	XX
Material	XX		
Labor	XX		
	XX		
Less inventory at close of period	XX		
Prime Cost	XX		
Factory Overhead	XX		
Cost of Sales	XX		
Balance, gross profit on manufacturing	XX		
	XX		XX
Selling expense	XX	Gross Profit on Manufacturing	XX
Traveling	XX		
Donations	XX		
Subscriptions	XX.		
Entertainment	XX		
Balance, gross profit on trading	XX		
	XX		XX
		Gross Profit from Trading Account	XX
Balance, net profit	XX	Discount on Purchases	XX
	XX		XX

The foregoing Profit and Loss account illustrates the form that is used when it is desired to set up the profit and loss for a period in the way that the account would appear on a properly kept ledger. The *pro-forma* account presented would answer for a manufacturing concern. All of the cost accounts on the ledger appear on the statement, and the results of the manufacturing and trading and net profit are shown.

The Profit and Loss account is shown arranged in less technical form in Section 449. From the gross sales are deducted the sales discounts, returns, allowances, and freight outward in order to determine the net sales. From this is deducted the cost of sales and selling and administrative expenses so as to obtain the gross profit on trading. Finally, the discount on purchases is added to the gross profit on trading in order to obtain the net profit for the period.

449. Trading and Profit and Loss Account, Report Form.

TRADING, PROFIT AND LOSS ACCOUNT OF THE A B C CO.
FOR THE YEAR ENDED DECEMBER 31, 19—

Gross Sales		XX
Less Discount on Sales	XX	
" Sales Returns	XX	
" Sales Allowances	XX	
" Outbound Freight	XX	XX
Net Sales		XX
Cost of Sales		XX
Gross Profit on Manufacturing		XX
Selling Expense	XX	
Traveling	XX	
General Expense	XX	
Donations	XX	
Subscriptions	XX	
Bad Debts	XX	
Entertainments	XX	XX
Gross Profit on Trading		XX
Add Discount on Purchases		XX
Net Profit		XX

450. Complete Set of Financial Statements.— A properly operated cost system makes it possible to obtain a complete set of financial statements at the close of each accounting period. In order to show how a set of properly prepared statements looks reference is made to the following exhibits taken from the report of the S. B. Weaving Co., entitled as follows:

Exhibit A. Balance Sheet
Exhibit B. Profit and Loss Statement
Exhibit B. Schedule 1, Analysis of Sales
Exhibit B. Schedule 2, Cost of Sales

A study of the exhibits will show how the cost figures interlock with the financial reports. On the Profit and Loss Statement one will see that the cost of sales amounts to $81,739.71. This figure is analyzed according to style numbers of fabrics sold in Schedule 1, and according to the various elements of cost in Schedule 2. Such an analysis of costs as presented is impossible without a cost system. It will be seen in Schedule 1 that a manufacturing profit was made on all but one style. On Style 30 the loss was $643.69, a leak discovered through the cost system. It is in such matters that a cost system reaches its highest usefulness.

THE S. B. WEAVING CO.
NEW YORK

Exhibit A

BALANCE SHEET
AS OF
JANUARY 31, 1920

Assets		
Current assets:		
Cash		$5,100.00
Accounts Receivable		30,510.25
Inventories:		
Finished Stock	$27,238.99	
Raw Materials and Work in Process	91,877.87	
Supplies	1,314.66	120,431.52
Total Current Assets		$156,041.77
Other assets:		
Machinery and Equipment	$53,695.86	
Less Reserve for Depreciation	5,622.66	48,073.20
Reeds and Harness	$10,207.90	
Less Reserve for Depreciation	4,188.66	6,019.24
Office Equipment	$ 221.00	
Less Reserve for Depreciation	30.00	191.00
Insurance Prepaid		926.42
Rent Prepaid		111.30
Total Assets		$211,362.93
Liabilities		
Current liabilities:		
Accounts Payable		$ 47,599.50
Notes Payable		54,183.65
Total Current Liabilities		$101,783.15
Other liabilities:		
Taxes Accrued		294.71
Water Rates Accrued		55.50
Total Liabilities		$102,133.36
Net Worth		
Capital, January 1, 1920	$50,000.00	
Surplus	51,619.83	
Profit for January, 1920 (per Exhibit B)	7,609.74	
Net Worth, January 31, 1920		109,229.57
		$211,362.93

exhibit B — Schedule 1

ANALYSIS OF SALES FOR JANUARY, 1920

Style	Pounds	Yards	Cost of Sales		Sales		Profit		Loss	
			Total	Per Yard Cents	Total	Per Yard Cents	Total	Per Yard Cents	Total	Per Yard Cents
6	5,544.34	91,642 1/4	$68,977.80	75.26	$81,101.37	88.49	$12,123.57	13.23		
22	8.46	77 3/4	70.39	90.59	96.87	124.59	26.48	34.00		
30	925.20	10,280 3/4	11,645.89	113.28	11,002.20	107.00			$643.69	6.28
39	6.88	76 1/2	61.14	79.92	84.15	110.00	23.01	30.08		
41	23.11	262 7/8	201.60	76.70	269.55	102.57	67.95	25.87		
43	3.11	35 1/2	35.21	99.12	39.05	110.00	3.84	10.88		
44	2.53	27 1/2	16.61	60.18	31.77	115.02	15.16	54.84		
50	20.90	234 3/8	195.52	83.34	234.63	100.00	39.11	16.66		
57	7.81	71 1/2	66.76	93.37	85.80	120.00	19.04	26.63		
60	23.56	538 3/8	468.79	87.08	599.87	111.42	131.08	24.34		
Totals	6,574.99	103,248	$81,739.71		$93,545.26		$12,449.24		$643.69	
Net							$11,805.55			

Exhibit B

INCOME AND PROFIT AND LOSS STATEMENT FOR JANUARY, 1920

Sales, 103,248 yards (Schedule 1)		$93,545.26
Less Cost of Sales (Schedules 1 and 2)		81,739.71
Profit on Manufacturing		$11,805.55
Less Selling Expenses:		
Commissions	$2,987.18	
Miscellaneous Expenses	930.03	3,917.21
Profit on Selling		$ 7,888.34
Less Interest		278 60
Net Profit for January, 1920 per Exhibit A.		$ 7,609.74

Exhibit B — Schedule 2

COST OF SALES FOR JANUARY, 1920

Raw Material and Production in Process, Jan. 1, 1920		$72,896.91
Purchases, 9,337 lb. silk at $9.80 average		91,468.17
Direct Expenses		
Wages:		
Entering	$ 209.45	
Twisting	246.00	
Weaving	11,904.30	
Inspecting and Measuring	297.07	
Picking	564.11	
Shipping	30.60	
Freight and Express	705.71	
Total Direct Expenses		13,957.24
Indirect Expenses		
Operating Expenses:		
Wages of Superintendent (Part)	$ 69.70	
Foremen	377.95	
Loom Fixers	1,552.85	
Smash Pieces	374.05	
Drop Wires	115.80	
Filling Carrier	156.70	
Oiler	32.29	
Spare Weavers	9.98	
Watchman	93.60	
Clerical	110.20	
Carpenter	38.94	
General Help	133.74	
Picker Sticks	300.00	
Heat and Power	577.11	
Rent	366.30	
Water	5.55	
Repairs	126 83	
Depreciation on Machinery and Equipment	268.48	
Depreciation on Reeds and Harness	305.02	
Total Operating Expense		5,015.09
Carried forward		$183,337.41

COST OF SALES FOR JANUARY, 1920—*Continued*

Brought forward		$183,337.41
Office Expenses:		
Wages	$ 153.20	
Stationery	22.60	
Telephone	5.73	
Depreciation on Office Equipment	1.20	
Total Office Expenses		182.73
General Expenses:		
Taxes	$ 22.67	
Insurance	88.91	
New York Office (part)	777.19	
Total General Expenses		888.77
Total Manufacturing Cost		$184,408.91
Less Inventory of Raw Material and Work in Process, Jan. 31, 1920		91,877.87
Cost of Production		$ 92,531.04
Plus Inventory of Finished Goods, Jan. 1, 1920		16,447.66
		$108,979.70
Less Inventory of Finished Goods, Jan. 31, 1920		27,238.99
Cost of Sales for January, 1920		$ 81,739.71

451. **Summary.**— The proper operation of a complete cost system requires that it be tied in with the financial records. The operation of a cost system provides for a system of book inventories run in connection with controlling accounts. Inasmuch as the inventory accounts represent the investment in material on hand at the close of each accounting period it makes the preparation of financial statements, Balance Sheet, and Profit and Loss account an easy matter. Each case must be studied in order to ascertain whether the financial statements should be prepared in account form or in the report form. The prevailing practice seems to be to prepare the Balance Sheet in account form unless it is desired to conserve space as when a statement is to be published in a newspaper. Profit and Loss statements are usually presented in report form as more readily understood.

QUESTIONS ON CHAPTER XXXV

1. In arranging the assets and liabilities on the Balance Sheet what order should be followed? Give an example.
2. In extractive industries what order do the assets usually follow?

3. What is the best form to follow in arranging a Trading and Profit and Loss account?
4. Illustrate what is meant by the interlocking of cost and financial accounts.
5. How can cost data be used in connection with the preparation of monthly financial statements?
6. Fro mthe data contained in the following Trial Balance prepare a Balance Sheet and Profit and Loss Statement for the X-Construction Co.

   Work on contracts A and B has been finished but work on C is only partially completed. It is estimated that an expenditure of $5,000 will be required to be made in addition to the liabilities on the books in order to finish C.

TRIAL BALANCE, X-CONSTRUCTION CO.

Cash		$ 65,000	
Accounts Receivable:	A	20,000	
	B	40,000	
	C	10,000	
Accounts Payable:	A		$ 10,000
	B		10,000
	C		7,500
Capital			10,000
Surplus			10,000
Cost of Construction:	A	75,000	
	B	150,000	
	C	37,500	
Contracts	A		100,000
	B		200,000
	C		50,000
		$397,500	$397,500

CHAPTER XXXVI

MECHANICAL AIDS IN COST WORK

452. Devices for Mathematical Calculations.— Accountants are frequently asked to recommend some mechanical device which will help reduce the amount of clerical work in connection with the various cost-figuring operations. Various devices which are on the market are a great aid in performing the operations of addition, multiplication, division, and subtraction. Certain machines are designed not only to perform these various operations but also to print the results. Some of the mechanical devices are electrically actuated and are quite elaborate in design, requiring special card forms punched in an analogous manner to the rolls used in an automatic player piano, or the cards used in a Jacquard loom. A brief explanation will be given of a few of those mechanical aids that are most useful in cost work. No mention will be made here of weighing machines, clocks, or time-recording devices because these have been referred to in Parts III and IV.

453. Comptometer.— The Comptometer is a most useful all-around device for cost work. It is adapted for addition, multiplication, division, and subtraction. Any one familiar with the meaning of common arithmetical terms can quickly learn to operate the Comptometer. It is not difficult to learn the method of operation, though to acquire the necessary skill of the fingers is difficult and requires considerable practice. Being a key-operated machine, like the typewriter, much practice is required to insure rapidity.

Addition requires more practice than any other operation before speed and accuracy are obtained. Multiplication requires comparatively little practice, but in multiplication care must be taken to follow certain rules, because certain methods which an operator is likely to adopt are not as rapid as might be. Division is more difficult to learn, but easy to remember, and though it requires more practice than multiplication, it does not require nearly as much as addition.

Any cost accountant will find it advantageous to become a good Comptometer operator, which he can do by using the machine for his regular work 20 minutes a day for two or three months. The more practice per day the better, as speed only comes through practice.

One feature of the Comptometer which distinguishes it from all other calculating instruments is its capacity to receive the work as fast as the most expert operator can touch the keys. Owing to the light touch, an operator can maintain a high speed without fatigue. No error results if two or more keys are depressed at once. In operating the Comptometer there is nothing to do but touch the keys. The speed at which work can be turned out on it is limited only by the skill of the operator.

454. Adding and Listing Machines.— If it is desired to list the items to be added and to record the footings as if the data were being typewritten, an adding and listing machine has to be used. The principal advantage in using a listing machine is that if it is desired to check back the items added, it can easily be done and any errors quickly detected. By devising special forms for use in connection with the adding and listing machine many valuable records can be made at the same time the items are being added.

The operation of the listing machine is extremely simple. Figures are recorded by merely touching the tops of the keys and pulling a handle or, on the electrically operated machine, by touching a bar. After each addition, the adding wheels show the total, which may be printed at any time by simply depressing a total key while the handle is moved forward or the bar touched.

Some machines are equipped with two sets of adding wheels, each of which will accumulate a total up to the full keyboard capacity of the machine. The advantage in this arrangement is that individual groups of items can be listed and totaled, and then the grand total of all the groups can be obtained. This is convenient for securing totals of each workman's earnings, for example, and then a grand total of all at one operation. This is accomplished by the use of a transfer key by means of which each group total is printed, cleared from the upper adding wheels, and transferred to the lower adding wheels where the grand total is accumulated. The use of two sets of adding wheels also provides a means of adding two sets of items,

each of which can be accumulated into a total. Thus, the earnings of day workers can be added in the upper adding wheels and piece workers in the lower ones. The operation of the two sets of wheels is controlled by a lever which is located at the left side of the keyboard. When the lever is set in the position of "Upper Counter," items listed are totaled in the upper set of adding wheels; when in the "Lower Counter" position, the items are added in the lower set of wheels.

Listing machines can be used for multiplication. Suppose, for example, it is desired to figure the cost of 3,425 machine parts at $2.14 per hundred. The extension involves multiplication which can be accomplished readily. The result would look as follows:

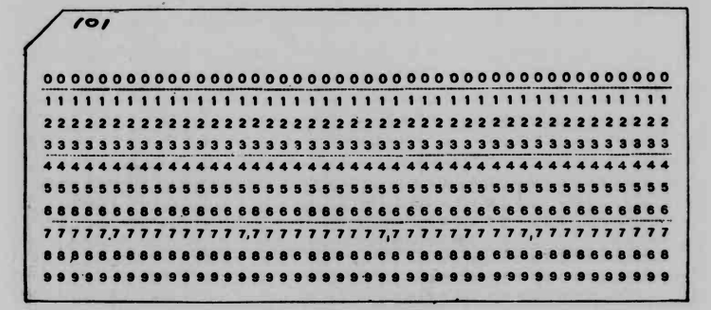
34.25
34.25
34.25
34.25
342.50
3,425.00
3,425.00
7,329.50

By pointing off the result the proper number of places, the amount in dollars and cents is obtained.

Besides the machines arranged to add and list dollars and cents, special machines can be obtained for adding feet and inches; dozens and gross; fractions of ¼, ⅛, 1/12, 1/16, 1/32, 1/64; hours and minutes; tons and hundredweights; pounds and bushels; pounds, shillings, and pence; and so on.

455. Punch Card.— In large-sized plants "Punch Cards," Form 101, which are adapted for use in automatic sorting and tabulating machines can frequently be introduced to lessen the clerical work involved in handling cost data. These cards are punched with holes in a manner similar to the rolls used in an automatic player piano or the cards used in a Jacquard loom. The punch cards, as they are called, have been given wide publicity in connection with the work of the Census Bureau in Washington, on which account they are sometimes spoken of as "Census cards." The use of punch cards in automatic sorting and tabulating machines has a wide range of application in connection with handling all sorts of cost records, and so the punch-card system will be explained somewhat in detail.

If it is desired to introduce the punch-card system for recording and tabulating cost records, it is first necessary to devise a special card to be used. A blank card is shown in Form 101. It will be noticed that on this card there are 45 columns of numbers each starting with 0 at the top and ending with 9 at the bottom. The first



FORM 101. PUNCH CARD

step in designing a punch card for tabulating purposes is to divide the 45 vertical columns into groups, called fields, which correspond to the different classes of information to be recorded on the card.

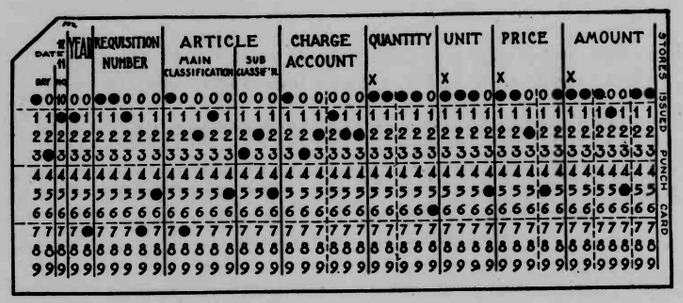
456. Stores Issued Punch Card.— In order to illustrate how the punch-card system can be adapted to cost-keeping requirements, reference will first be made to the method of making a record of stores issues. Thus, for example, it may be necessary to record the following information regarding each item of stores issued:

Date of issue
Requisition number
Article
Charge-account classification
Quantity
Unit
Price
Amount

In order to provide for recording information under each of the foregoing heads it is necessary that the card be divided into separate

fields as shown in the " Stores-Issued Punch Card," Form 102. The number of columns allotted to each class of information is, of course, dependent upon the size of the numerical code required to record the data.

For example, codes are referred to as four-place, six-place, eight-place codes and so on, meaning that it requires four, six, or eight numbers to record the information. The method of making up a numerical code for use in classifying information was explained in a previous chapter. It must be understood that all information recorded on the punch cards is in the form of numbers which correspond



FORM 102. STORES ISSUED PUNCH CARD

to certain data. When the facts to be recorded are in the shape of numbers as in the case of quantities and amounts of money, no difficulty is experienced in indicating the data in the fields under the proper headings shown on the card. However, if it is desired to record the fact that the article issued is oak lumber 2 by 12 inches, it is necessary to refer to an index showing the code numbers assigned each article and to obtain the number which corresponds to the article to be recorded. Suppose that the index gives the following information:

Lumber,	7200.
Lumber, oak	7,215.
2″ x 12″	325

The main and sub-classification can be recorded in the statistical fields on Form 102 as follows:

Article

Main Classification	Sub-Classification
• 0 0 0 0	0 0 0
1 1 1 • 1	1 1 1
2 2 • 2 2	2 • 2
3 3 3 3 3	• 3 3
4 4 4 4 4	4 4 4
5 5 5 5 •	5 5 •
6 6 6 6 6	6 6 6
7 • 7 7 7	7 7 7
8 8 8 8 8	8 8 8
9 9 9 9 9	9 9 9

Reading the article classification from the above fields in the card one sees that the main classification is 7,215, and the sub-classification 325, which is shown in the code book to be oak lumber 2 by 12 inches. Other information is shown in the proper fields in a similar manner. It is quite common to refer to the columns used for classification purposes as " statistical " fields in contrast to the " adding " fields used for recording quantities and amounts.

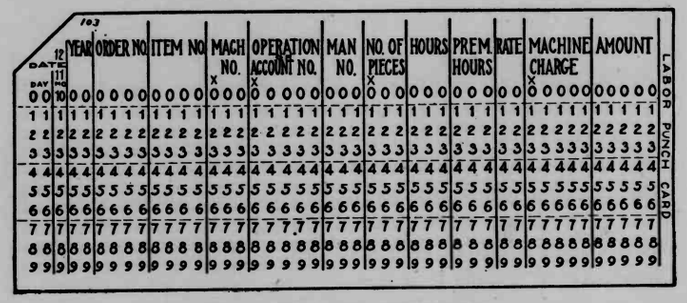
The advantage of the punch-card system lies in the fact that after the cards have been prepared once they can be sorted according to the various classifications in each statistical field, whereas in the case of hand-written records it is necessary to make as many records as there are classifications to be made. Thus, the cards can be sorted by article classification first and then tabulated, after which operation they can be again sorted by account classification and tabulated. As many sortings and tabulations as desired may be provided for by means of the various statistical fields up to the limit of the capacity of the card.

In the case of a Stores-Issued Punch Card (Form 102) one sorting would be required by article classification to obtain the necessary information for posting the Stock Record, and another sorting would be required to obtain such needed information about the account to be charged, as the job-order number, process account, or the Departmental Overhead Expense account. The results of the tabulation made after each sorting must agree in all cases. This forms a check on the accuracy of the work of tabulating.

On each card there are certain reference columns such as the date and requisition-number columns shown at the left and used for the

purpose of identifying the document from which the card was punched.

The foregoing description of the design and operation of punch cards is suggestive of the method of procedure in devising any cards needed to meet the varying conditions of different plants. As far as material is concerned punch cards are mostly used to record and analyze purchases, stores received, and stores issued. The analysis of purchases is made in order to provide for the distribution of vendors' claims in accordance with a purchasing agent's classification of commodities for purely statistical purposes, and for the purpose of making a distribution of vouchers in accordance with General-



FORM 103. LABOR PUNCH CARD

Ledger account classifications and also in such detail as may be required for cost purposes. The analysis of stores received is usually made by kinds of articles for Stock-Record purposes, while the analysis of stores issued is made by articles for Stock-Record purposes and also for cost-accounting purposes in order to obtain the cost of material used on each job, or in each process. It is from the analyses of stores received and stores issued that the Stock-Record cards are posted at the end of each week or month. When this system is used bin tags must be depended upon for a record of current balances. The balances shown on the Stock-Record cards at the close of each week or month should, of course, agree with the balances shown on the bin tags as previously stated, thereby providing an internal check on the accuracy of stores accounts.

457. Labor Punch Card.— To further illustrate the adaptability

of the punch-card system to cost work reference will be made to the card used for recording labor costs and shown in Form 103. The various statistical fields provide for classifying the labor cost according to the order or other reference number as well as the machine, operation, or account number. Provision is also made for recording the number of the operator, number of pieces produced, hours worked, overtime or bonus and rate. The machine-charge column is used to show the amount of expense charged to the job for the use of the machine. The card shown is very complete and with very slight changes is suitable for use in a large number of plants.

458. Key Punch.— The mechanism generally used for punching the cards is a Key Punch. The punch is equipped with a set of keys, numbered from 0 to 9 inclusive, and also with an X key. When the operator wants to make a record a card is first inserted and then the keys are depressed in a similar manner to those on a typewriter and the card feeds automatically so that after each hole is made the card moves ahead to let the next column to the right come into place under the punches. A skilled operator learns to operate the key punch very rapidly, making as many as 3,000 card records daily under favorable conditions. When a large number of cards are to be punched with the same date or reference number, a gang punch is provided for the purpose, by means of which a number of cards can be punched simultaneously with the same characters. It is quite usual to punch the date and reference number by means of a gang punch.

459. Punching Machine.— Another type of punch is known as the punching machine. The unpunched cards are placed at the back of the machine and automatically fed. Data to be transferred to the card are set up on a rack. The key board is equipped with 45 key bars, each of which has 12 notches. These keys are in colors, white, black, red, and blue, arranged on the key board to correspond with the vertical divisions or fields, printed on the punch cards. This type of keyboard is readily operated, as the palm of the hand rests on a plain plate at the bottom of the keyboard, while four fingers of each hand can be used readily in pulling down as many key bars as needed to the desired point. One great advantage of this method is that the complete setting of the machine can be read along the edge of the plate before the punch is tripped, enabling the operator

to verify the setting and to correct it if necessary before punching the card. After setting the keys the operator presses the foot pedal which trips the clutch, raises the dies and card-holding mechanism against the punch, and punches the entire number of holes at one stroke, after which the card is automatically fed into the front holder.

460. **Proof of Accuracy in Punching.**— It is necessary to provide some means of proving the accuracy with which the work of punching is done. There are several methods in vogue for doing this. One method is to have two different operators punch cards containing the same data and then to compare the two sets of cards obtained by holding them up to the light to see if the holes correspond. Another method is to add the information contained on the original documents and then to compare the result with the totals obtained from tabulating the punch cards. If this plan is followed, it is necessary to add not only amount columns but also statistical columns in order to see that the numbers in any classification code have not been punched wrongly. Thus, for example, in a department store where sales are recorded on punch cards the audit of sales consists in adding up the amount of all sales and also the numbers showing the stock classifications, and then in comparing the results with the totals obtained by adding the corresponding items on the cards themselves. A further check in this particular case is obtained by adding the salesmen's daily tallies of sales to see that the total of the items entered on the separate sales slips agrees with the total obtained from the tallies. Each case must be separately studied to learn just what steps need to be taken to prove the accuracy with which cards have been punched.

461. **Automatic Sorting Machine.**— The next step after punching the cards is to sort them in accordance with the classification codes in the various statistical columns. This can be accomplished readily by means of a specially-designed automatic sorting machine. The machine is provided with pockets to sort the cards according to the numbers punched out in any column desired. If the classification code is of more than one place, as is the case where a four-, six-, or eight-place code is used, additional sortings are required until the distribution is finally made by separate code numbers, after which the cards are ready for tabulating.

462. **Automatic Tabulating Machine.**— If each card represented one unit in the same way that a census card gives the facts about one person, all that would be necessary to obtain the desired information about any one item would be to count all the cards containing the classification number of the item in question. However, in cost accounting by means of punch cards it is always necessary to add the amounts on each card and sometimes the quantities also. To accomplish this the automatic tabulating machines can be used. These machines, which are electrically actuated, tabulate the information to be added on the cards of any one classification as they are automatically fed. The machines have three counters so that totals can be added to obtain a grand total if desired. Machines can be obtained with four or five counters when the work requires an additional number. A shelf projects in front of the machine upon which the operator can lay the sheets used for recording the results of the tabulation. The machine works very rapidly and is capable of tabulating several hundred cards per minute.

463. **Tabulator-Printer.**— If it is desired to print the record made from the punch card, it is necessary to make use of a machine called a Tabulator-Printer. This is an automatic adding machine operated by means of the punch cards. It prints and accumulates the data perforated upon each individual card. One advantage of the printing feature of the tabulator is evident when it becomes necessary to check punched cards with the original records from which they were perforated, either to verify the transcription or to locate an error made either in punching or in the original record. Several carbon copies can be made simultaneously by placing carbon paper between the records upon which the results or lists are recorded. The advantage of this is apparent. For instance, it is possible to prepare from the cards duplicate or triplicate copies of a report, retain a copy, and yet send out what is an absolute transcription of their detailed records, if desired.

One advantage of using the punch-card system is that during the current month the cards can be prepared daily and at the end of the month quickly sorted and tabulated to obtain the information required to close the books and for posting to the detail cost records. From the description given of the punch-card system it is seen that there is considerable detail of a rather complex nature involved in handling the records from the time when the original classification

code is prepared until the time when the final tabulation is made. The system requires careful supervision in order that good results may be obtained from its use. Under good management in large plants records can be kept with greater detail and figures more quickly obtained than in the case of hand-written records and at a much smaller expense for clerical work. The sorting and tabulating machines are ordinarily leased on a royalty basis by the owners of the patents so that the expense of rental is about the same as the cost of the services of a competent clerk, and the machines can do more work than several clerks when installed and operated under favorable conditions. Key punches are sold outright to the users of the system. The extent to which punch cards can be adapted to meet the requirements of a cost system depends upon the ingenuity of the cost accountant.

464. Summary.— Every cost department should be equipped with any mechanical aids necessary to expedite the work of making calculations. The larger the department the more elaborate the mechanical aids needed. In very large offices a complete installation of automatic tabulating machinery for use in connection with a system of punch cards is desirable.

Questions on Chapter XXXVI

1. What use can be made of a Comptometer in cost work?
2. What use can be made of adding and listing machines in cost work?
3. What use can be made of automatic sorting and tabulating machines in cost work? What is the function of the punch cards?
4. How is a numerical code used in connection with the automatic sorting and tabulating of cost data? Give an example.
5. How is the key punch used in connection with the punch cards?
6. What are the advantages of the punching machine over the key punch?
7. How is the automatic sorting machine used?
8. How is the automatic tabulating machine used?
9. How does the Tabulator-Printer work?

CHAPTER XXXVII

GRAPHIC CHARTS

465. Visualizing Cost Data.— After statistics relative to costs, sales, profits, and so on have been obtained and tabulated, it is oftentimes desirable to adopt the graphic method of presentation. Properly drawn charts are especially valuable for administrative purposes because it is possible by means of heavy lines to bring out the peaks and hollows in connection with various sets of data and also to indicate the trend upward or downward of certain transactions. Unless presented graphically, increases and decreases in the current expenses or revenues may not be noticed. In other words, differences between the amounts shown for the current period and prior periods can be visualized better by means of lines than by tables of figures, especially if proper explanatory matter accompanies them. The commonest charts are those in which equal spaces represent equal amounts, quantities, or intervals of time, a difference of a half-inch, for example, meaning $1,000 or 100 tons, or some other quantity, a day, week, month, or some other period of time. Charts showing the data of various transactions chronologically, called histograms, should be arranged to be read from left to right, as a book is read. Difference charts are prepared on cross-section paper, like that used by engineers and sometimes referred to as "coördinate paper," the vertical lines being the ordinates and the horizontal lines the abscissas.

466. Ratio Charts.— It is desirable frequently to show ratios of increase and decrease rather than simple differences. By preparing charts showing ratios it is possible to compare hours worked with amounts paid for labor, tons produced, cost of production, and so on. It is also practicable to compare large quantities or amounts with small ones, as, for example, the total cost of sales each month with the cost of each element of the cost of sales. Ratio charts are drawn on logarithmically ruled paper, that is, the spaces are proportional to the logarithms of numbers. Ratio, or logarithmically ruled, paper

can be purchased ready for use or it can be prepared by drawing lines at proper intervals, which can be spaced according to the divisions on the slide in an engineer's slide-rule.

467. Special Charts.— Under certain conditions special charts showing deviations from the moving average or the correlation be-

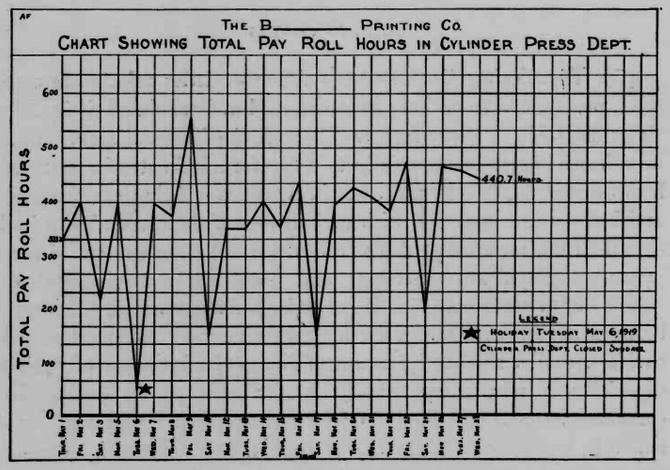


EXHIBIT AF. CHART SHOWING TOTAL PAYROLL HOURS IN A CYLINDER PRESS DEPARTMENT

tween two related sets of data can be prepared for the purpose of presenting certain facts. The extent to which the graphic presentation of cost data can be carried is dependent upon the ingenuity of the cost accountant.

Several charts will be presented and explained in order to make clear the application of the principles involved in their preparation. Data used for plotting curves were taken from actual records. The four charts to be explained first are drawn on ordinary cross-section paper, the spaces representing equal differences; all four charts are histograms.

468. Chart Showing Total Payroll Hours in a Cylinder-Press Department.— A good method of showing cyclical variations is to prepare a graph on cross-section paper. The graph also brings out

TABLE 1. CYLINDER PRESS DEPARTMENT PAYROLL HOURS

Week Ended	Thursday	Friday	Saturday	Monday	Tuesday	Wednesday	Total
May 7.....	333.2	389.5	218.2	397.5	532.	398.	2,268.4
May 14.....	373.5	559.5	155.2	358.7	354.	401.7	2,202.6
May 21.....	351.2	433.2	141.	392.	421.	409.7	2,148.1
May 28.....	385.5	471.2	191.7	464.	456.2	440.7	2,409.3
Totals	1,443.4	1,853.4	706.1	1,612.2	1,763.2	1,650.1	9,028.4

the peaks and hollows. Thus, there is usually a variation in the total of the payroll hours in a department of a factory from day to day. Table 1 shows the daily payroll hours for a period of four weeks in the cylinder-press department of a job-printing establish-

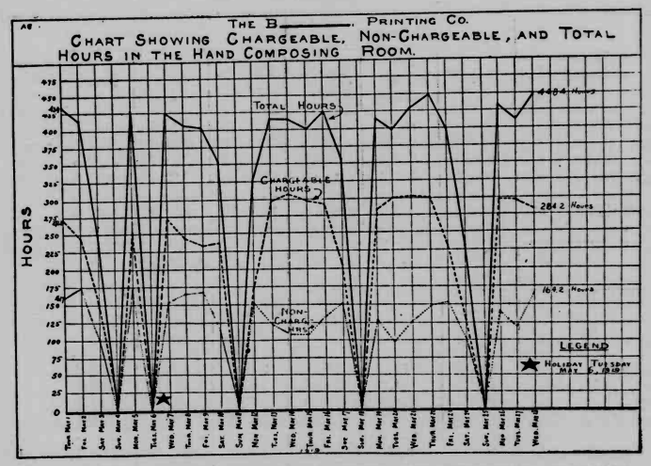


EXHIBIT AG. CHART SHOWING CHARGEABLE, NON-CHARGEABLE, AND TOTAL HOURS IN THE HAND COMPOSING ROOM

ment. The data contained in the table are plotted graphically in the histogram shown in Exhibit AF. The most violent fluctuations took place on Tuesday, May 6, the drop in payroll hours being caused by a holiday, and on Friday, May 9, the peak being caused by excessive overtime on a rush job. The ordinary cyclical variations show that the peak in payroll hours in the department comes on Friday and the hollow on Saturday. The plant is closed Sundays.

469. Chart Showing Chargeable, Non-Chargeable, and Total Hours in a Hand-Composing Room.— A comparison between the chargeable and non-chargeable hours as well as the total hours worked in the department of a factory can be brought out graphically in a histogram. The data given in Table 2 shows the composing-room hours in a job-printing establishment by days for a period of four weeks. The data in this table are set out graphically in Exhibit AG. One will note at once the large number of non-chargeable hours. The cyclical variations are quite uniform except for Tuesday, May 6, when there was a drop in the curves due to a holiday.

TABLE 2. COMPOSING-ROOM HOURS

Week Ended	Thursday			Friday		
	Chargeable	Non-Chargeable	Total	Chargeable	Non-Chargeable	Total
May 7	272.3	161.7	434.0	243.2	174.5	417.7
May 14	240.0	167.9	407.9	234.9	168.3	403.2
May 21	294.0	107.2	401.2	289.8	135.7	425.5
May 28	302.5	147.4	449.9	236.1	153.4	389.5
Total	1,108.8	584.2	1,693.0	1,004.0	631.9	1,635.9
	Saturday			Monday		
	Chargeable	Non-Chargeable	Total	Chargeable	Non-Chargeable	Total
May 7	146.9	100.3	247.2	255.7	172.5	428.2
May 14	238.0	114.2	352.2	174.9	153.5	328.4
May 21	206.5	151.4	357.9	285.5	131.9	417.4
May 28	128.6	103.4	232.0	294.6	139.8	434.4
Total	720.0	469.3	1,189.3	1,010.7	597.7	1,608.4
	Tuesday			Wednesday		
	Chargeable	Non-Chargeable	Total	Chargeable	Non-Chargeable	Total	Total Hours
May 7	8.7		8.7	270.0	154.0	424.0	1,959.8
May 14	295.1	122.6	417.7	309.1	107.3	416.4	2,325.8
May 21	301.1	96.1	397.2	303.4	127.0	430.4	2,429.6
May 28	293.5	119.2	412.7	284.2	164.2	448.4	2,366.9
Total	898.4	337.9	1,236.3	1,166.7	552.5	1,719.2	9,082.1

470. Chart Showing Labor and Expense per Yard in a Weaving Mill.— It is a very good plan to divide the total units of production into the cost to obtain the cost per unit of the product. The result gives a sort of index. The unit cost shows whether or not an increase in production results in an increase or decrease in cost. Unit costs given in Table 3 are plotted on coördinate paper as shown in Exhibit AH, the vertical lines being used for measuring costs

TABLE 3. PRODUCTION, LABOR AND EXPENSE BY MONTHS IN A WEAVING MILL

Month	Direct Labor			Operating Expense		General Expense		Total Labor and Expense	
	Yards Woven	Amount	Per Yard Cents	Amount	Per Yard Cents	Amount	Per Yard Cents	Amount	Per Yard Cents
January	25,142	$ 2,678	10.6	$ 2,740	10.9	$ 1,172	4.6	$ 6,590	26.1
February	27,135	2,587	9.5	3,160	11.6	1,169	4.3	6,916	25.4
March	33,110	3,051	9.2	2,899	8.8	1,162	3.5	7,112	21.5
April	46,378	4,242	9.1	3,850	8.3	1,159	2.5	9,251	19.9
May	61,609	5,622	9.1	3,970	6.4	1,215	1.9	10,807	17.4
June	52,066	4,913	9.4	4,039	7.8	1,370	2.6	10,322	19.8
July	69,170	6,746	9.8	4,739	6.8	1,273	1.8	12,758	18.4
August	54,848	5,408	9.9	4,088	7.4	1,282	2.3	10,778	19.6
September	87,217	8,530	9.8	5,089	5.8	1,321	1.5	14,940	17.1
October	82,324	7,726	9.4	4,775	5.8	1,298	1.6	13,799	16.8
November	77,572	7,421	9.6	4,868	6.3	1,295	1.7	13,584	17.6
December	80,878	7,619	9.4	4,835	6.0	1,047	1.3	13,501	16.7
Totals	697,449	$66,543		$49,052		$14,763		$130,358	

and the horizontal lines for months. In order to test the advantage of plotting unit costs on cross-section paper, all that is necessary is to make a comparison between the figures in the table and the chart in order to see how much easier it is to see the trend in transactions when the graphic method is used. It will be noticed by referring to the chart, Exhibit AH, that there has been a marked drop in the total labor and expense per yard, which is caused principally by a drop in the operating and general expense. Direct labor did not show a corresponding decrease because any increase in yards woven is attended by a corresponding increase in labor. The chart reveals a healthy condition in the weaving mill taken for illustration.

471. Chart Showing Average Selling Price per Pound and Average Cost of Sales per Pound in a Silk-Throwing Mill.— One of the most useful comparisons that can be made is between the average selling price and the average cost of sales per unit of product. The data given in Table 4 are shown plotted on cross-section paper in Exhibit AJ. The data are taken from a silk-throwing mill. It is seen by referring to the chart that there has been an upward trend

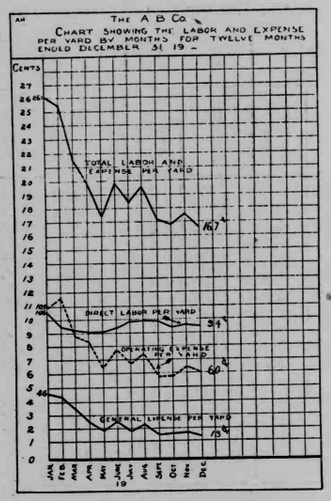


EXHIBIT AH. CHART SHOWING THE LABOR AND EXPENSE PER YARD BY MONTHS, WEAVING MILL (SEE TABLE, PAGE 423)

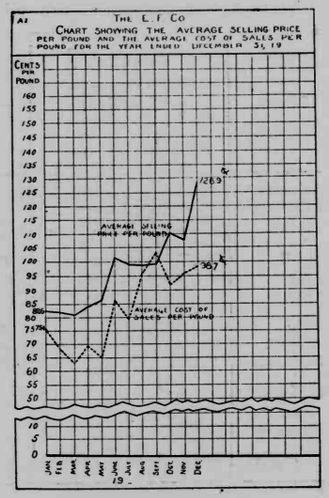


EXHIBIT AJ. CHART SHOWING THE AVERAGE SELLING PRICE PER POUND AND THE AVERAGE COST OF SALES PER POUND, SILK-THROWING MILL

in unit costs and sales during the year. In September the average cost exceeded the average selling price, resulting in a loss; after that the selling price was increased, with the result that a more favorable showing was made during the ensuing months. The chart is broken just above the bottom to indicate that a part has been taken out to save space. It is in the plotting of unit prices, such as cost prices, that the ordinary coördinate charts reach their highest state of usefulness.

472. Ratio Charts in General.— The charts immediately following are prepared on logarithmically ruled paper and are called ratio charts. A word of explanation about the general principles involved in preparing ratio charts may not be out of order because one should have an idea of the basic principles underlying their preparation.

Converting ordinary cross-section paper into ratio paper is accomplished readily by substituting the numbers 1, 10, 100, 1,000, 10,000, 100,000, 1,000,000 and so on for the numbers 0, 1, 2, 3, 4, 5, 6, and up, when numbering the lines. The former series of numbers runs

TABLE 4. AVERAGE SELLING PRICE PER POUND AND THE AVERAGE COST OF SALES PER POUND IN A SILK-THROWING MILL

Month	Pounds Produced	Sales		Cost of Sales	
		Amount	Per Pound Cents	Amount	Per Pound Cents
January	4,735	$ 3,912.59	82.60	$ 3,570.26	75.40
February	5,074	4,190.99	82.57	3,455.15	68.08
March	6,655	5,410.23	81.29	4,204.34	63.17
April	7,253	6,122.17	84.40	5,067.12	69.86
May	6,240	5,420.81	86.85	4,083.15	65.43
June	5,216	5,331.35	102.21	4,568.15	87.57
July	5,782	5,714.66	98.83	4,619.14	79.88
August	5,529	5,427.27	98.16	5,323.95	96.29
September	5,388	5,314.62	98.62	5,587.01	103.69
October	5,462	6,034.14	110.47	5,068.89	92.78
November	6,044	6,547.63	108.31	5,833.11	96.50
December	7,134	9,195.72	128.90	7,041.26	98.70
Totals	70,512	$68,622.18		$58,421.53	

geometrically, the multiplier being 10; the latter series runs arithmetically, the number 1 being added in each case. The arithmetical series of numbers are said to be the logarithms of the geometrical series; that is, the numbers in the latter series are the exponents required to raise the base 10 (the multiplier) to the corresponding number in the former series, thus:

$$10^0 = 1 \text{ or } \text{Log}_{10}\ 1 = 0$$
$$10^1 = 10 \text{ or } \text{Log}_{10}\ 10 = 1$$
$$10^2 = 100 \text{ or } \text{Log}_{10}\ 100 = 2$$
$$10^3 = 1000 \text{ or } \text{Log}_{10}\ 1000 = 3$$
etc.

Other series of numbers with the number 2, for example, could be used.

If equidistant horizontal lines on cross-section paper are given the geometrical series of numbers corresponding to the powers of 10, the plotting paper is said to be single logarithmically ruled. If, in addition to the horizontal lines, the vertical lines are also given the geometrical series of numbers, the plotting paper is said to be double logarithmically ruled. The special feature of single logarithmically ruled plotting paper is that a straight line means a fixed ratio of increase or decrease. The special feature of double logarithmically ruled plotting paper is that a straight line means that a fixed ratio of increase corresponds to a fixed ratio of decrease or *vice versa.* If an inch on the vertical lines measures an increase of 100 per cent on one part of a ratio chart, an inch upward on an ordinate in any other part of the chart also marks an increase of 100 per cent. By means of either single or double logarithmically ruled paper many problems can be visually represented. The method of operation will be understood readily from the illustrative exhibits given in this chapter.

473. Table of Logarithms of Numbers.— If it is desired to rule a sheet of paper so that the distance between the lines will be proportional to the logarithms of numbers, reference can be made to the following table. It will be noticed that the numbers in the number columns are equal to powers of 10. Reading across the table from left to right on the top row one finds 1, 10, 100, and 1,000; and on the second row 2, 20, 200, and 2,000. At the right of each number one finds the logarithm. A logarithm is made up of two parts; the characteristic is in front of the decimal point and the mantissa is at the right of the decimal point. The number of decimal places in the number determines the characteristic as follows:

Number	Characteristic
1000	3
100	2
10	1
1	0

The mantissa, or decimal part, of a logarithm is obtained from a table of logarithms such as engineers or mathemeticians use in their calculations. The same sequence of numbers always has the same mantissa, regardless of the characteristic. Thus 2, 20, 200, and 2,000 each have .3010 for a mantissa as shown in the following table:

LOGARITHMS OF NUMBERS

Number	Logarithm	Number	Logarithm	Number	Logarithm	Number	Logarithm
1	0.0000	10	1.0000	100	2.0000	1,000	3.0000
2	0.3010	20	1.3010	200	2.3010	2,000	3.3010
3	0.4771	30	1.4771	300	2.4771	3,000	3.4771
4	0.6021	40	1.6021	400	2.6021	4,000	3.6021
5	0.6989	50	1.6989	500	2.6989	5,000	3.6989
6	0.7781	60	1.7781	600	2.7781	6,000	3.7781
7	0.8451	70	1.8451	700	2.8451	7,000	3.8451
8	0.9031	80	1.9031	800	2.9031	8,000	3.9031
9	0.9542	90	1.9542	900	2.9542	9,000	3.9542
						10,000	4.0000

Reference can be made to the above table of logarithms when spacing the lines in a ratio chart. The spaces are proportional to the logarithms.

TABLE 5. PRODUCTION, SALES, COSTS, AND OPERATING PROFIT IN A WEAVING MILL

Month	Pounds Produced	Sales	Cost of Sales	Operating Profit	Operating Loss
January	3,222	$ 4,187.34	$ 3,458.66	$ 728.68	
February	2,290	3,065.56	3,815.25		$ 749.69
March	2,437	4,405.80	3,230.84	1,174.96	
April	2,665	4,073.92	3,353.78	720.14	
May	3,391	5,339.81	4,169.36	1,170.45	
June	3,321	6,258.69	4,087.20	2,171.49	
July	2,834	5,337.27	4,117.99	1,219.28	
August	2,104	3,456.81	4,072.87		616.06
September	3,267	5,977.46	4,689.56	1,287.90	
October	3,368	5,479.61	4,727.24	752.37	
November	2,735	5,774.39	4,722.39	1,052.00	
December	2,652	4,470.04	4,748.33		278.29
Totals	34,286	$57,826.70	$49,193.47	$10,277.27	$1,644.04
			Net	$ 8,633.23	

474. Ratio Chart Showing Production, Sales, and Operating Profits.— Data such as those in Table 5 can be plotted on logarithmically ruled paper to good advantage, as shown in Exhibit AK. The chart acts as a barometer of conditions in the silk-throwing mill from which its data were taken. It will be seen that during the months of February, August, and December there was a drop in production which resulted in a loss. The sales rise and fall with the production but the cost of sales remains more of a constant, as shown. The operating profit is the difference between the cost and sales. The

chart shown in Exhibit AK is suggestive of charts that can be prepared for other establishments than silk-throwing mills as administrative guides.

475. Ratio Chart Showing Production, Labor and Expense.— The total yards, labor, and expense shown in Table 3 are shown plotted on logarithmically ruled paper in Exhibit AL. The trend in yards woven, together with the peaks and hollows, is clearly brought

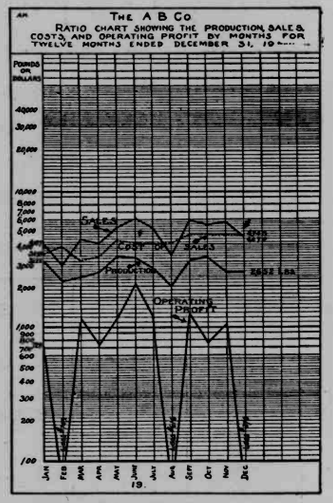


EXHIBIT AK. RATIO CHART SHOWING PRODUCTION, SALES, COSTS, AND OPERATING PROFIT BY MONTHS

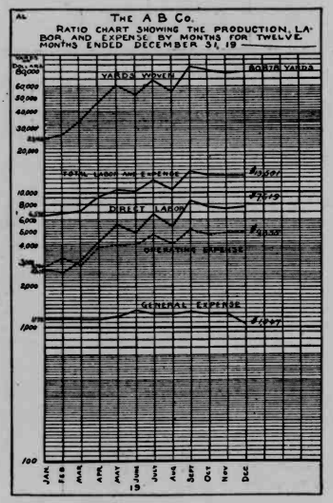


EXHIBIT AL. RATIO CHART SHOWING THE PRODUCTION, LABOR, AND EXPENSE

out. It will be noted that the direct labor rises and falls in the same ratio as the production, which is to be expected in a silk-weaving mill. However, the expense ratio has not increased so rapidly. By means of the chart it is easy to compare the last report with those preceding and quickly obtain a perspective of operating conditions. The mill appears to be making a favorable showing.

476. Ratio Chart Showing Hours, Payroll, and Average Amount of Payroll per 1,000 Hours.— The weekly payroll, hours, and average hourly labor costs given in Table 6 are plotted on the

TABLE 6. HOURS, PAYROLL, AND AVERAGE AMOUNT OF PAYROLL PER 1,000 HOURS, BY WEEKS, IN A SILK MILL

Date	Hours	Amount	Rate per 1,000 Hours	Date	Hours	Amount	Rate per 1,000 Hours
Jan. 4	3,176	$533.61	$168	May 3	2,616	$562.32	$215
" 11	3,142	531.19	169	" 10	3,002	608.46	203
" 18	3,057	503.12	164	" 17	2,772	533.00	192
" 25	3,426	557.99	163	" 24	2,959	624.74	211
Feb. 1	2,544	412.51	162	" 31	3,359	711.65	212
" 8	3,469	562.83	162	June 7	3,132	694.73	222
" 15	3,948	627.81	160	" 14	3,661	826.82	226
" 22	3,617	584.69	161	" 21	4,070	910.28	224
Mar. 1	3,748	641.51	171	" 28	3,397	737.18	217
" 8	3,487	603.90	173	July 5	4,450	970.99	218
" 15	3,544	601.70	170	" 12	4,050	921.59	227
" 22	3,736	642.60	172	" 19	4,156	916.41	220
" 29	3,147	582.08	185	" 26	2,777	603.83	217
Apr. 5	2,713	526.76	194	Aug. 2	3,730	833.41	223
" 12	3,182	615.45	193	" 9	3,646	840.87	230
" 19	3,285	658.21	200	" 16	4,085	911.63	223
" 26	2,966	612.38	206	" 23	4,228	939.42	222
				" 30	3,807	807.22	212

ratio chart shown in Exhibit AM. It will be seen readily that there has been a general upward trend in the average hourly earnings of operatives in the silk mill during the year from 16.8 cents per hour to 21.2 cents per hour. On May 17, the 20 cent an hour line was

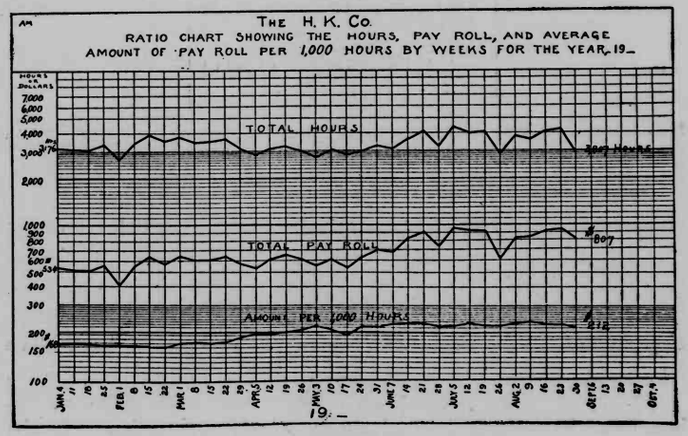


EXHIBIT AM. RATIO CHART SHOWING THE HOURS, PAYROLL, AND AVERAGE AMOUNT OF PAYROLL PER 1,000 HOURS

crossed for the second time, after which the rate remained above the line. The chart indicates how advantageously hours, payrolls, and average hourly earnings can be compared.

477. Ratio Chart Showing Make-Ready, Running Time and Total Impressions and Average Impressions per Hour.— Data pertaining to the three web printing presses of the two-color, 64 pp. type given in Table 7, is shown plotted on logarithmically ruled

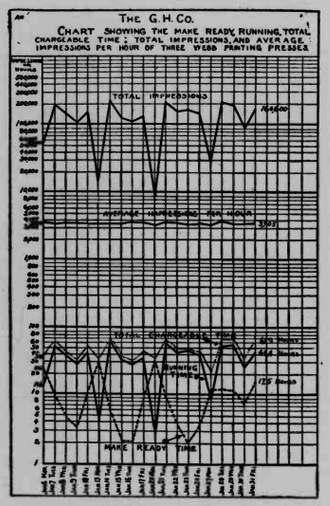


EXHIBIT AN. RATIO CHART SHOWING THE MAKE-READY, RUNNING, TOTAL CHARGEABLE TIME, TOTAL IMPRESSIONS, AND AVERAGE IMPRESSIONS PER HOUR OF THREE WEBB PRINTING PRESSES

paper in Exhibit AN. This is a daily chart. It will be seen that Mondays the total impressions drop due to the increase in the make-ready time on the job and the resulting decrease in running time. The sum of the make-ready and running time gives the total chargeable time on the job as shown by the dotted line on the chart. The most constant element is the average number of impressions per hour. The chart is interesting because it shows how small numbers like hours can be compared to advantage with large numbers like the total impressions.

TABLE 7. CHARGEABLE HOURS AND IMPRESSIONS OF THREE WEBB PRINTING PRESSES

Date	Chargeable Hours.			Total Impressions	Impressions Per Hour Running Time
	Make-Ready	Running	Total		
Jan. 6, Monday	24.5	14.6	39.1	56,000	3,830
" 7, Tuesday	8.4	54.4	62.8	194,000	3,566
" 8, Wednesday	4.7	38.6	43.3	147,500	3,821
" 9, Thursday	3.4	28.3	31.7	108,500	3,833
" 10, Friday	10.2	42.9	53.1	154,800	3,600
" 13, Monday	30.2	4.2	34.4	15,540	3,700
" 14, Tuesday	5.7	62.2	67.9	224,800	3,614
" 15, Wednesday	2.2	34.3	36.5	124,500	3,623
" 16, Thursday	2.2	28.3	31.0	112,000	3,882
" 17, Friday	9.4	34.9	44.3	130,400	3,732
" 20, Monday	31.0	2.8	33.8	9,000	3,211
" 21, Tuesday	9.1	58.1	67.2	219,900	3,783
" 22, Wednesday	3.7	43.9	47.6	157,500	3,583
" 23, Thursday	2.1	46.9	49.0	161,300	3,439
" 24, Friday	3.8	39.7	43.5	146,200	3,681
" 27, Monday	13.5	8.9	22.4	29,500	3,314
" 28, Tuesday	13.6	54.3	67.9	216,000	3,974
" 29, Wednesday	12.6	54.8	67.4	194,000	3,540
" 30, Thursday	7.7	25.9	33.6	92,000	3,552
" 31, Friday	17.5	44.4	61.9	164,600	3,705

478. Ratio Chart Showing Pounds of Cotton Purchased, Amount Paid for Cotton, and Average Price per 100 Pounds.— Data taken from the books of a knitting mill pertaining to cotton purchased, amounts paid, and average price per 100 pounds are shown in Exhibit AP. It will be noticed that although the purchases fluctuated widely from month to month the average price paid remained somewhat of a constant, as one would expect. The highest price was in May after which there was a steady decline until the end of the year. By means of the chart very large figures can be compared readily with small ones, as pounds purchased with the price paid.

479. Ratio Chart Showing the Days, Payroll, and Number of Papers Printed, on an Eight-Page Basis, in the Press Department of a Newspaper.— In some manufacturing enterprises the organization required for production is quite constant. Under such

conditions it is a good plan to make a comparison of current payroll expenditures with what may be termed the basic organization. Table 8 shows the days, payroll, and number of papers printed on an eight-page basis in the press department of a newspaper. It will be noticed that the $30 a week clerk was dropped February 20, and so he

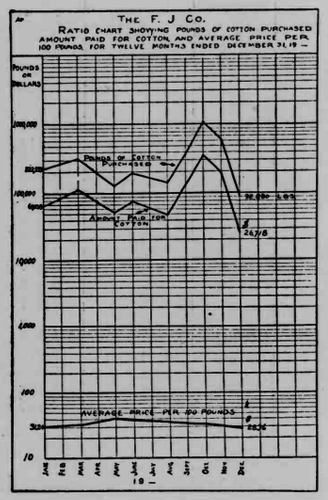


EXHIBIT AP. RATIO CHART SHOWING POUNDS OF COTTON PURCHASED, AMOUNT PAID FOR COTTON, AND AVERAGE PRICE PER 100 POUNDS KNITTING MILL

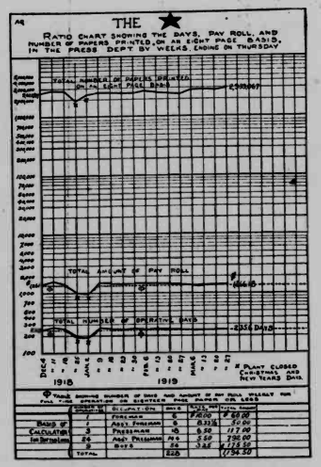


EXHIBIT AQ. RATIO CHART SHOWING THE DAYS, PAYROLL, AND NUMBER OF PAPERS PRINTED, ON AN EIGHT-PAGE BASIS, IN THE PRESS DEPARTMENT OF A NEWSPAPER

will be omitted in the graphic chart altogether in order to get a fair basis of comparison from week to week. Reference to Exhibit AQ shows the total number of operative days and the corresponding payroll compared with the days and payroll for regular fulltime operation. The drops during the weeks ended December 25 and January 2 are explained by the fact that newspapers are not published on Christmas Day and on New Year's Day in New York. Otherwise the horizontal lines representing operative days and payroll remain about straight, as one would expect.

TABLE 8. DAYS, PAYROLL AND NUMBER OF PAPERS PRINTED IN THE PRESS DEPARTMENT OF A NEWSPAPER

Week Ended	Grand Total		Number of Papers on an Eight-Page Basis
	Days	Amount	
Dec. 4.....	231.9	$1,261.74	2,422,877
" 11.....	261.0	1,431.50	2,803,626
" 18.....	241.6	1,283.95	2,702,392
" 25.....	190.2	1,010.68	1,936,786
Jan. 2.....	188.1	992.80	2,254,656
" 9.....	250.7	1,362.45	2,546,833
" 16.....	243.4	1,328.58	2,445,206
" 23.....	240.5	1,297.41	2,462,526
" 30.....	246.2	1,329.68	2,430,353
Feb. 6.....	238.6	1,336.64	2,712,162
" 13.....	242,7	1,321.41	2,487,727
" 20.....	237.6	1,308.24	2,388,229
" 27.....	235.8	1,272.26	2,290,554
Mar. 6.....	227.0	1,201.25	2,780,682
" 13.....	231.0	1,226.62	2,805,636
" 20.....	234.4	1,251.87	2,753,275
" 27.....	235.6	1,266.18	2,933,067
Total.....	3,976.3	$21,483.26	33,156.587

480. Ratio Chart Showing Payroll and Hours in Composing Room.—Various statistics pertaining to labor costs and operating efficiency can be shown better in graphic form than in any other

TABLE 9. COMPOSING-ROOM HOURS AND PAYROLL

Week Ended	Chargeable Hours	Non-Chargeable Hours	Total Payroll Hours	Amount	Average Per Chargeable Hour	Average Per Total Payroll Hour	Ratio of Chargeable to Total Hours, Per Cent
May 7	1,181.3	771.7	1,953.0	$1,489.38	$1.2611	$0.7621	60.48
May 14	1,458.5	833.8	2,292.3	1,682.03	1.1536	0.7338	63.61
May 21	1,638.7	749.3	2,388.0	1,863.12	1.1374	0.7801	68.62
May 28	1,511.3	827.4	2,338.7	1,716.96	1.1355	0.7343	64.62
	5,789.8	3,182.2	8,972.0	$6,751.49	$1.1661	$0.7524	64.52

fashion. Table 9 contains the statistics relative to composing-room hours and payrolls for four weeks. These data are set up in a histogram, logarithmically ruled, as shown in Exhibit AR. One will at once observe that the number of non-chargeable hours is large. The ratio of chargeable to total hours is shown to be 64.62 per cent.

This, of course, tends to increase the departmental labor costs. The payroll per chargeable hour averages $1.1661 and ended with $1.1355 for the week of May 28, as shown. The low payroll and hours for

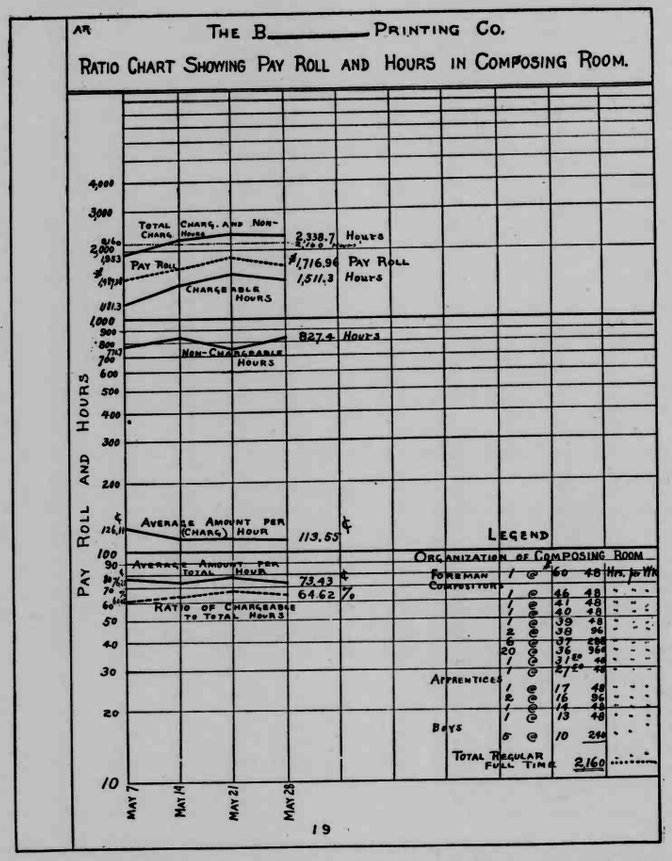


EXHIBIT AR. RATIO CHART SHOWING PAYROLL AND HOURS IN COMPOSING ROOM

the week ended May 7 was due to a holiday. The legend shows the organization of the composing room. Total regular full time is 2,160 hours weekly. Similar ratio charts can be made for any depart-

ment of a factory and when made provide a valuable administrative guide.

481. Ratio Chart Showing Remainder Values Corresponding to Several Fixed Rates of Increase and Decrease per Annum.—In the early part of this chapter it was stated that one of the properties of logarithmically ruled paper is that straight upward diagonal

TABLE 10. REMAINDER VALUES CORRESPONDING TO SEVERAL FIXED RATES OF INCREASE AND DECREASE PER ANNUM FOR A TEN-YEAR PERIOD

Year	Percentages of Increase					
	1	2	5	10	15	20
0	100.00	100.00	100.00	100.00	100.00	100.00
1	101.00	102.00	105.00	110.00	115.00	120.00
2	102.01	104.04	110.25	121.00	132.25	144.00
3	103.03	106.12	115.76	133.10	152.09	172.80
4	104.06	108.24	121.54	146.41	174.89	207.36
5	105.10	110.40	127.61	161.05	201.12	248.83
6	106.15	112.60	133.99	177.15	231.28	298.59
7	107.21	114.85	140.69	194.86	265.96	358.29
8	108.28	117.14	147.72	214.34	305.84	429.95
9	109.36	119.48	155.10	235.77	351.71	515.85
10	110.45	121.87	162.85	259.34	404.46	619.01
	Percentages of Decrease					
	1	2	5	10	15	20
0	100.00	100.00	100.00	100.00	100.00	100.00
1	99.00	98.00	95.00	90.00	85.00	80.00
2	98.01	96.04	90.25	81.00	72.25	64.00
3	97.03	94.12	85.74	72.90	61.42	51.20
4	96.06	92.24	81.46	65.61	52.21	40.96
5	95.09	90.40	77.39	59.05	44.38	32.77
6	94.14	88.59	73.52	53.15	37.72	26.23
7	93.20	86.82	69.85	47.84	32.06	20.99
8	92.27	85.08	66.36	43.06	27.25	16.81
9	91.35	83.38	63.04	38.75	23.17	13.45
10	90.44	81.72	59.89	34.88	19.70	10.77

lines indicate percentage of increase and straight downward lines indicate fixed percentage rates of decrease. In order to make this clear the data shown in Table 10 have been plotted in Exhibit AS. From the chart one sees that straight lines on logarithmically ruled paper indicate fixed rates of increase or decrease.

482. Double Ratio Chart Showing Remainder Values Corresponding to Several Fixed Rates of Increase and Decrease.—The vertical as well as the horizontal rulings in Exhibit AT are spaced geometrically and so the chart is spoken of as a double-ratio chart. In order to illustrate the properties of a double-ratio chart

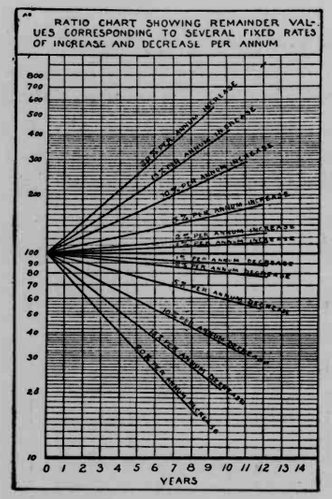


EXHIBIT AS. RATIO CHART SHOWING REMAINDER VALUES CORRESPONDING TO SEVERAL FIXED RATES OF INCREASE AND DECREASE PER ANNUM

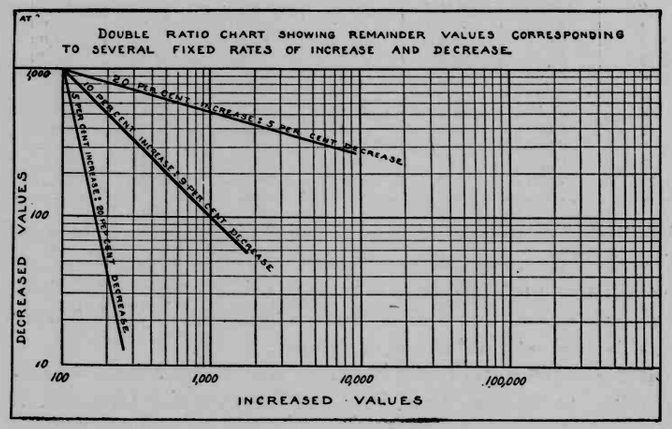


EXHIBIT AT. DOUBLE RATIO CHART SHOWING REMAINDER VALUES CORRESPONDING TO SEVERAL FIXED RATES OF INCREASE AND DECREASE

Table 11 has been prepared showing remainder values at the end of each period corresponding to several fixed rates of increase and decrease. It will be seen that when the data in Table 11 are plotted in Exhibit AT, the lines obtained by joining the points are all

TABLE 11. REMAINDER VALUES AT THE END OF EACH PERIOD CORRESPONDING TO SEVERAL FIXED RATES OF INCREASE AND DECREASE

Period	First Pair		Second Pair		Third Pair	
	20 Per Cent Increase	5 Per Cent Decrease	10 Per Cent Increase	9 Per Cent Decrease	5 Per Cent Increase	20 Per Cent Decrease
0	100	1,000	100	1,000	100	1,000
1	120	950	110	910	105	800
2	144	902	121	828	110	640
3	173	857	133	753	116	512
4	207	814	146	686	121	409
5	249	774	161	624	128	328
6	298	735	177	568	134	262
7	358	698	195	517	141	210
8	430	663	214	470	148	168
9	516	630	236	428	155	134
10	619	599	259	389	163	107
11	743	569	285	354	171	86
12	892	540	314	322	179	69
13	1,070	513	345	293	188	55
14	1,284	488	380	267	198	44
15	1,540	463	417	243	208	35
16	1,848	440	459	221	218	28
17	2,218	418	505	201	229	23
18	2,661	397	556	183	240	18
19	3,194	377	611	167	253	14
20	3,832	358	672	152	265	11
21	4,598	341	740	138	278	9
22	5,518	324	814	126	292	7
23	6,622	307	895	114	306	6
24	7,946	292	984	104	322	5
25	9,535	277	1,083	95	338	4

straight. A straight line on a double-ratio chart always means that a fixed rate of increase corresponds to a fixed rate of decrease.

483. Double Ratio Chart Showing the Average Income Corresponding to the Number of Income-Tax Returns, by Classes. — In order to give a practical illustration of the use of a double-ratio chart for plotting data, reference will be made to income-tax statistics, because here we have one series of numbers representing the average income and another series representing the number of incomes on each class; one series decreases while the other increases. The data given in Table 12 pertaining to the average income and the number of returns have been plotted as shown in Ex-

hibit AU, and a line drawn through the points obtained. As one would expect, the lower ranges of incomes correspond to the larger number of income-tax returns. With the exception of the broken portion at the lower end, the line is straight. We can easily figure out what percentage of increase in the number of income returns corresponds to a certain percentage of decrease in the amount. The calculation made shows that a decrease of *one* per cent in the average

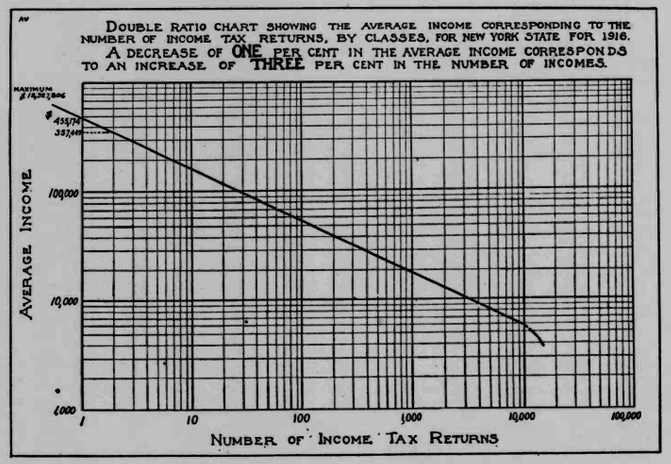


EXHIBIT AU. DOUBLE RATIO CHART SHOWING THE AVERAGE INCOME CORRESPONDING TO THE NUMBER OF INCOME TAX RETURNS BY CLASSES

income corresponds to an increase of *three* per cent in the number of incomes. Whenever an analogous situation is met with, and data containing both an increasing and decreasing series of numbers are to be analyzed, the double-ratio chart should be made use of.

A practical application of how advantageously this form might be used in combining two series of variable data, is to be found in the case of a producing concern which has a substantial monopoly of the product, or of some essential raw material; let us imagine that a manufacturer of gasoline practically controlled the supply of petroleum. He would be faced with the problem of determining the price per gallon. If he were to put it as low as 15 cents per gallon he would

induce a tremendous number of sales, and his gross income would be the number of gallons sold multiplied by 15 cents. His production cost would be relatively high and his net profit figuratively low. On the other hand, if he were to fix the price at 50 cents a gallon a great many people driving cheap cars would have to forego automobile

TABLE 12. DISTRIBUTION OF INCOMES BY CLASSES FOR NEW YORK STATE FOR 1916 (Treasury Department, "Statistics of Income," 1916, p. 79)

Range of Incomes	Class Interval A	Number of Returns B	Number of Returns for Each $1,000 Class Interval B ÷ (A ÷ 1,000)	Total Income C	Average Income C ÷ B
$ 3,000–$ 4,000	1,000	15,034	15,034	$54,809,417	$ 3,622
4,000– 5,000	1,000	13,820	13,820	62,147,564	4,497
5,000– 6,000	1,000	10,313	10,313	56,300,356	5,459
6,000– 7,000	1.000	7,498	7.498	48,643,746	6,487
7,000– 8,000	1,000	5,483	5.483	41.192,570	7,513
8,000– 9,000	1,000	4,199	4,199	35,780,396	8,521
9,000– 10,000	1,000	3,392	3,392	32.356,478	9,539
10,000– 15,000	5,000	9,810	1,962	120,173,753	12,250
15,000– 20,000	5,000	5,418	1,083	94,386,071	17,420
20,000– 25,000	5,000	3,254	651	73,475,589	22.580
25,000– 30,000	5,000	2,178	435	60.001,649	27,549
30,000– 40,000	10,000	2,800	560	97,814.125	34,933
40,000– 50,000	10,000	1,674	167	75,285,656	44,973
50,000– 60,000	10,000	1.091	109	60,213,011	55.190
60,000– 70,000	10,000	792	79	51,461.940	64,977
70,000– 80,000	10,000	563	56	42,187,370	74.933
80,000– 90,000	10,000	472	47	40,625.231	86,070
90,000– 100,000	10,000	372	37	35,562,652	95,598
100,000– 150,000	50,000	1,006	20	124,573,155	123,830
150,000– 200,000	50,000	467	9	81.881,346	175.334
200,000– 250,000	50,000	304	6	68,927,386	226.734
250,000– 300,000	50,000	165	3	46,026,040	278,945
300,000– 400,000	100,000	191	2	65.295,290	341,859
400,000– 500,000	100,000	99	1	45,062,292	455,174
500,000–1,000,000	500,000	187		128,358,838	686,410
1,000,000–1,500,000	500,000	54		65,805,247	1,218,616
1,500,000–2,000,000	500,000	23		38,371,128	1,668,309
2,000,000–3,000,000	1,000,000	20		49,414,804	2,470,740
3,000,000–4,000,000	1,000,000	11		37,887,862	3,444,351
4,000,000–5,000,000	1,000,000	6		27,207,157	4,534,526
5,000,000 and over		5		61,636,532	12,327,806

transportation and gasoline would be sold to the comparatively small body of purchasers who could afford to indulge in an expensive luxury. The selling price would be high, the total sales very low, and the gross income probably lower than in the first case, and with no great proportional drop in the cost of production, though the net

TABLE 13. MOVING AVERAGE OF YARDS WOVEN AND WEAVING LABOR IN A WEAVING MILL, WITH INCREASES AND DECREASES, TWELVE MONTHS

Month	Woven Yards	Moving Average, Yards Woven	Increase of Yards Woven Over Moving Average	Decrease of Yards Woven Under Moving Average	Weaving Labor	Moving Average, Weaving Labor	Increase of Weaving Labor Over Moving Average	Decrease of Weaving Labor Under Moving Average
January	25,142	27,135		1,993	$2,090.85	$2,229.14		$138.29
February	27,135	28,362		1,327	2,178.80	2,301.91		123.11
March	33,110	35,541		2,431	2,636.10	2,832.73		196.63
April	46,378	47,032		654	3,683.30	3,805.40		122.10
May	61,609	53,351	8,258		5,096.80	4,346.95	749.85	
June	52,066	60,948		8,882	4,260.75	5,142.35		881.60
July	69,170	58,694	10,476		6,069.50	5,018.66	1,050.84	
August	54,848	70,412		15,564	4,725.75	6,063.95		1,338.20
September	87,217	74,796	12,421		7,396.60	6,391.03	1,005.57	
October	82,324	82,371		47	7,050.75	7,002.96	47.79	
November	77,572	80,258		2,686	6,561.55	6,848.93		287.38
December	80,878	89,953		9,075	6,934.50	7,683.24		748.74
Totals	697,449	708,953	31,155	42,659	$58,685.25	$59,667.25	$2,854.05	$3,836.05
Net Decrease	11,504		11,504		982.00		982.00	
	708,953	708,953	42,659	42,659	$59,667.25	$59,667.25	$3,836.05	$3,836.05

profit might be slightly higher than in the first case. However, there is a point at which the price could be fixed at which the monopolist would reap a gross income which would be in most favorable proportion to the cost of production and, therefore, yield the greatest monopoly profit. To a lesser degree this same sort of information is valuable to all concerns, though they may be more restricted in their power to fix prices than a great monopolist.

484. Chart Showing Deviations Above and Below the Moving Average.— One might expect that the payroll in a weaving mill would increase and decrease according to the rise and fall in pro-

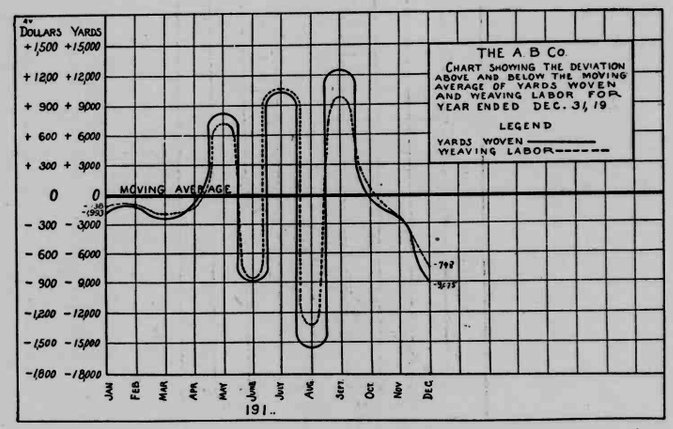


EXHIBIT AV. CHART SHOWING THE DEVIATION ABOVE AND BELOW THE MOVING AVERAGE OF YARDS WOVEN AND WEAVING LABOR

duction. In order to show the relation between payroll and production the data given in Table 13 are plotted on cross-section paper taking the moving average as the base. The moving average is the figure obtained by adding three months together and taking the average, then dropping off the first month and adding another, and again taking the average. The scale of dollars to yards is taken as 1 to 10 as shown. It will be seen by referring to Exhibit AV that the solid line (yards woven) closely follows the dotted line (weaving labor). When there is a close relation between costs and production the curves take the form shown in the chart.

485. Chart Showing Correlation Between Yards Woven and Weaving Labor.— In order to measure the closeness of the relations existing between two sets of related data, it is necessary to calculate the coefficient of correlation as shown in Table 14, in which the Pearsonian coefficient is used. Then the results are plotted on cross-section paper as shown in Exhibit AW. The result obtained by drawing a line central to the points obtained shows that the correla-

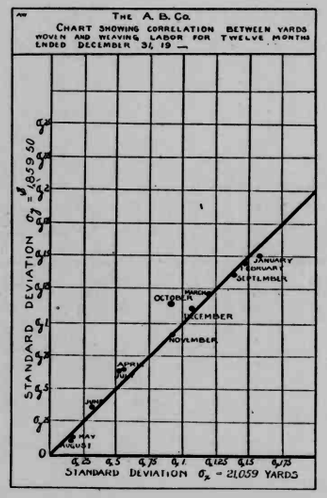


EXHIBIT AW. CHART SHOWING CORRELATION BETWEEN YARDS WOVEN AND WEAVING LABOR

tion is about perfect. The line passes through the squares at an angle of 45 degrees, as would be expected, for the coefficent shown in Table 10 is +.998. Absolutely perfect correlation is +1.0.

486. The Normal Curve of Error.— A chapter on graphic charts is not complete without making at least a reference to frequency distributions and the normal curve of error. By frequency is meant the number of employees in each class of wage earners, for example. It is apparent that in any factory there are a few highly paid employees while the approach to the lower ranges of compensation is marked by an increase in the number of workers until a point

TABLE 14. PEARSONIAN COEFFICIENT OF CORRELATION BETWEEN YARDS WOVEN AND WEAVING LABOR IN A WEAVING MILL FOR TWELVE MONTHS

Month	Yards Woven	Deviation from Average x	x^2	Weaving Labor	Deviation from Average y	y^2	xy
January	25,142	− 32,978	1,087,548,000	$2,090.85	− $2,799.59	$7,834,401	92,305,422
February	27,135	− 30,985	960,070,000	2,178.80	− 2,711.64	7,349,521	84,000,335
March	33,110	− 25,010	625,500,000	2,636.10	− 2,254.34	5,080,516	56,372,540
April	46,378	− 11,742	137,874,000	3,683.30	− 1,207.14	1,456,849	14,172,594
May	61,609	+ 3,489	12,173,000	5,096.80	+ 206.36	42,436	718,734
June	52,066	+ 6,054	36,650,000	4,260.75	+ 629.69	395,641	3,807,966
July	69,170	+ 11,050	122,002,000	6,069.50	+ 1,179.06	1,390,041	13,027,950
August	54,848	+ 3,272	10,705,000	4,725.75	+ 164.69	26,896	536,608
September	87,217	+ 29,097	846,635,000	7,396.60	+ 2,506.16	6,280,036	72,917,082
October	82,324	+ 24,214	586,317,000	7,050.75	+ 2,160.31	4,665,600	52,302,240
November	77,572	+ 19,452	378,380,000	6,561.55	+ 1,671.11	2,792,241	32,504,292
December	80,878	+ 22,758	517,926,000	6,934.50	+ 2,044.06	4,177,936	46,517,352
Totals	697,449		5,321,780,000	$58,695.25		$41,492,114	469,183,115
Average	58,120		443,482,000	$ 4,890.44		$ 3,457,676	39,098,593

$$\sigma_x = \sqrt{\frac{\Sigma x^2}{n}} = \sqrt{443{,}482{,}000} = 21{,}059.0 \qquad \sigma_y = \sqrt{\frac{\Sigma y^2}{n}} = \sqrt{3{,}457{,}676} = 1859.5$$

$$\frac{xy}{n} = 39{,}098{,}593 \qquad \frac{xy}{n} = 39{,}098{,}593$$

$$\text{Pearsonian Coefficient of Correlation} = r = \frac{\quad}{\sigma_x\,\sigma_y} = \frac{\quad}{21059.0 \times 1859.5} = +.998$$

is reached where the numbers thin out again and finally the lowest paid operatives are reached. Usually the employees are arranged or grouped about the node or point of greatest frequency. The form of curve taken in frequency distributions where the vertical lines represent a number of items in each class and the horizontal lines the class interval is that of a bell. The curve is distinguished by being symmetrical. The greatest number are grouped about the mode and taper off on each side. The true curve can be produced from Newton's Binomial Theorem. It is called the normal curve of error because a represents as many successes in the binomial as x does of failures.

According to Newton's Binomial Theorem a and x expanded to the twentieth power gives the following result:

$$
\begin{aligned}
(a+x)^{20} = a^{20} &+ 20\,a^{19}x + 190\,a^{18}x^2 + 1{,}140\,a^{17}x^3 \\
&+ 4{,}845\,a^{16}x^4 + 15{,}504\,a^{15}x^5 + 38{,}760\,a^{14}x^6 + 77{,}520\,a^{13}x^7 \\
&+ 125{,}970\,a^{12}x^8 + 167{,}960\,a^{11}x^9 + 184{,}756\,a^{10}x^{10} + 167{,}960\,a^{9}x^{11} \\
&+ 125{,}970\,a^{8}x^{12} + 77{,}520\,a^{7}x^{13} + 38{,}760\,a^{6}x^{14} + 15{,}504\,a^{5}x^{15} \\
&+ 4{,}845\,a^{4}x^{16} + 1{,}140\,a^{3}x^{17} + 190\,a^{2}x^{18} + 20\,ax^{19} + x^{20}.
\end{aligned}
$$

From the foregoing the coefficients of the 21 terms are as follows:

Terms	Number of Coefficient	Terms	Number of Coefficient
1	1	12	167,960
2	20	13	125,970
3	190	14	77,520
4	1,140	15	38,760
5	4,845	16	15,504
6	15,504	17	4,845
7	38,760	18	1,140
8	77,520	19	190
9	125,970	20	20
10	167,960	21	1
11	184,756		

It will be noted that the binomial theorem has the following properties:

1. $(a + x)^m$ is composed of $m + 1$ terms, of which the first is a^m and the last is x^m.

2. The exponent of a decreases by 1 in passing from one term to the next, and therefore becomes 0 for the last term; the exponent of x increases by 1 from one term to the next, starting at the first term as 0, and becoming m for the last term.

3. The coefficient of a term is obtained by multiplying the coefficient of the preceding term by the exponent of a in that term, and dividing the product by 1 plus the exponent of x in the same term.

487. Chart showing the Normal Curve of Error Based on Newton's Binomial Theorem.— If the data shown in the foregoing table are plotted on ordinary cross-section paper using the ordinates for the coefficients and the abscissas for the various terms and the points are joined by a line, the result obtained, as shown by Exhibit AX, is called the "normal curve of error." It represents symmetrical distribution about the middle ordinate. One will note the bell shape. The inside line shows the curve that is obtained when

TABLE 15. FREQUENCY TABLE SHOWING THE NUMBER OF EMPLOYEES AT EACH FIVE-DOLLAR RANGE OF WEEKLY COMPENSATION COMPARED WITH THE NORMAL CURVE OF ERROR

Weekly Rates of Compensation	Number of Employees	Percentage of Employees	Coefficients of Terms in Binomial Expansion	Percentages
Less than $5.00	0	0.00	1	.39
$5.00 to $9.99	6	8.22	8	3.12
10.00 to 14.99	13	17.81	28	10.94
15.00 to 19.99	15	20.55	56	21.88
20.00 to 24.99	19	26.04	70	27.34
25.00 to 29.99	13	17.81	56	21.88
30.00 to 34.99	1	1.36	28	10.94
35.00 to 39.99	5	6.85	8	3.12
40.00 to 44.99	1	1.36	1	.39
Totals	73	100.00	256	100.00

the ordinates are drawn one-half the original length. The relative height and width are determined by the length taken for the distances on the horizontals.

488. Frequency Chart Showing the Percentage of Employees at Each Five-Dollar Range of Weekly Compensation Compared with the Normal Curve of Error.— The curve of error is used in statistical work to measure the closeness of fit of a frequency distribution with the normal distribution. Thus, for example, one may want to ascertain whether or not the employees in a plant when grouped according to weekly earnings follow the normal law of symmetrical distribution. Reference to Exhibit AY shows

how the data in Table 15 have been plotted, showing the percentage of employees at each $5 range of compensation compared with the normal curve of error. It appears that the highest percentage is in the $20 to $24.99 a week class, and comes at the center of the curve or at the node as it is called. It will be seen that the groups for the lower ranges of compensation deviate a little from the curve, us-

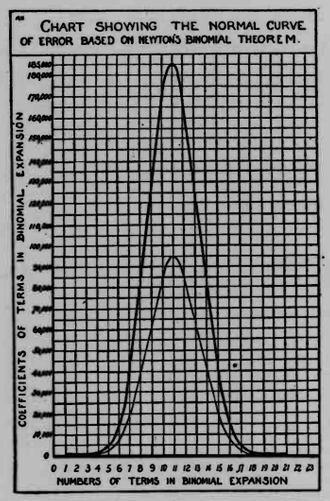


EXHIBIT AX. CHART SHOWING THE NORMAL CURVE OF ERROR BASED ON NEWTON'S BINOMIAL THEOREM, PLOTTED FROM THE COEFFICIENTS GIVEN ON PAGE 444

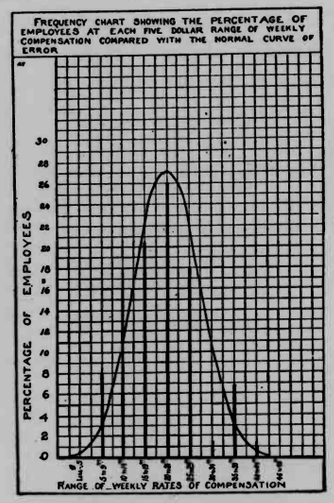


EXHIBIT AY. FREQUENCY CHART SHOWING THE PERCENTAGE OF EMPLOYEES AT EACH FIVE DOLLAR RANGE OF WEEKLY COMPENSATION COMPARED WITH THE NORMAL CURVE OF ERROR

ually above, while in the upper ranges of wage rates the variation is down and up. One reason for the lack of uniformity is that the data were taken from a small factory where but 73 operatives were employed. If a large plant had been taken, greater symmetry would undoubtedly have been obtained.

489. Summary.— From the charts presented in this chapter one sees that there is a wide field in which the cost accountant can use his ingenuity for depicting various items of information pertaining to

production, payrolls, costs, and comparisons of one kind or another. Difference charts on ordinary cross-section paper are best suited for recording the trend in prices or a single quantity. Ratio charts on logarithmically ruled paper are best suited for making comparisons between series of data with different units, as money and weight values. Special charts can be prepared for the purpose of presenting cost data graphically. The various charts presented are suggestive of what can be done in this field by the cost accountant.

QUESTIONS ON CHAPTER XXXVII

1. What use can be made of graphic charts in connection with cost work?
2. What sorts of charts are best adapted to present unit costs and to show the trend in prices?
3. How are ratio charts ruled?
4. What two kinds of ratio charts are there?
5. What does a straight line represent in each of the two kinds of ratio charts?
6. For what sorts of data are ratio charts best suited?
7. Plot the following data on a ratio chart:

Month	Yards Woven			
	Mill A	Mill B	Mill C	Total Yards
January	15,343	7,134	3,222	25,699
February	13,992	4,735	2,290	21,017
March	12,432	5,074	2,437	19,943
April	12,708	6,655	2,665	22,028
May	11,672	7,253	3,391	22,316
June	15,583	6,240	3,321	25,144
July	15,552	5,216	2,834	23,602
August	15,731	5,782	2,104	23,617
September	15,214	5,529	3,267	24,010
October	13,885	5,388	3,368	22,641
November	17,158	5,462	2,735	25,355
December	13,720	6,044	2,652	22,416
Total	172,990	70,512	34,286	277,788

8. Take the number 100, and increase it at the rate of 12½ per cent per annum for 15 years, and then take the number 1,000 and decrease it at the rate of 15 per cent per annum for the same period. Plot the results obtained on double-ratio paper.
9. Using the data given in Table 7 for hours and amounts, prepare a table showing the Pearsonian coefficient of correlation and plot the results on cross-section paper.
10. What is the normal curve of error? How is it obtained?
11. Expand $(a \times x)^{15}$ and plot the normal curve of error.

12. What is meant by a frequency distribution? What is its relation to the normal curve of error?
13. From the data contained in the following mortality table prepare a chart on logarithmically ruled paper, using the ordinates for the "number of books remaining" and the abscissas for the "life of books in months." What does the shape of the curve indicate? At what rate are the books discarded?

    The books are worth on an average $1 each. Does the stock of books depreciate according to the fixed proportion, fixed percentage on diminishing value, or sinking-fund method? Give the reason for your answer.

MORTALITY TABLE SHOWING THE NUMBER OF ADULT BOOKS DISCARDED AT THE END OF EACH MONTH IN THE BROOKLYN PUBLIC LIBRARY, FROM A LOT OF 960 BOOKS

Life of Books in Months	Number of Books Discarded	Number of Books Remaining	Life of Books in Months	Number of Books Discarded	Number of Books Remaining
0	0	960	37	36	532
1	1	959	38	9	523
4	2	957	39	15	508
5	3	954	40	14	494
6	4	950	41	17	477
7	1	949	42	11	466
8	2	947	43	17	449
9	2	945	44	12	437
10	6	939	45	19	418
11	5	934	46	22	396
12	5	929	47	8	388
13	2	927	48	36	352
14	5	922	49	26	326
15	10	912	50	12	314
16	11	901	51	7	307
17	12	889	52	7	300
18	9	880	53	3	297
19	8	872	54	8	289
20	11	861	55	4	285
21	19	842	56	5	280
22	12	830	57	11	269
23	16	814	58	7	262
24	9	805	59	4	258
25	14	791	60	12	246
26	8	783	61	10	236
27	8	775	62	7	229
28	30	745	63	1	228
29	15	730	64	2	226
30	20	710	65	2	224
31	14	696	66	6	218
32	10	686	67	4	214
33	21	665	68	7	207
34	20	645	69	6	201
35	16	629	70	4	197
36	61	568	71	5	192

MORTALITY TABLE OF BOOKS — *Continued*

Life of Books in Months	Number of Books Discarded	Number of Books Remaining	Life of Books in Months	Number of Books Discarded	Number of Books Remaining
72	18	174	105	4	64
73	16	158	106	2	62
74	3	155	107	3	59
75	2	153	108	2	57
76	4	149	109	2	55
77	6	143	110	2	53
78	3	140	112	4	49
79	2	138	113	1	48
80	7	131	115	3	45
81	1	130	116	5	40
82	1	129	117	1	39
83	4	125	118	3	36
84	8	117	120	1	35
85	2	115	121	1	34
86	1	114	123	3	31
87	2	112	126	5	26
88	3	109	127	1	25
89	4	105	128	2	23
90	5	100	129	3	20
91	2	98	130	1	19
92	3	95	131	1	18
93	5	90	132	1	17
94	3	87	133	2	15
95	4	83	134	1	14
96	1	82	137	2	12
99	3	79	138	3	9
100	6	73	139	1	8
101	2	71	142	3	5
103	1	70	144	1	4
104	2	68	145	1	3
			146	2	1
			153	1	0

Median Life 40 months (3 yrs., 4 mos.).
Average Life 49 months (4 yrs., 1 mo.).
Modal Life 36 months (3 years).

PART VII

EXAMPLES OF COMPLETE COST SYSTEMS

CHAPTER XXXVIII

INTRODUCTION TO COMPLETE COST SYSTEMS

490. Study of Conditions Necessary.— When introducing a complete cost system into a business enterprise, it is necessary to make a preliminary study of conditions to determine what type of cost system is best suited to meet the needs of the case. Certain general rules can be laid down as a guide or indicator of what mode of treatment is best suited to meet certain conditions. In working out the details of the system for any particular enterprise, the cost accountant must rely on his own judgment to obtain the best results. Several examples showing the operation of cost-accounting systems under a variety of conditions will be presented as a guide to be followed by anyone wishing to introduce and put into operation a complete system of costs. The illustrative cost accounts which are given in connection with the various systems constitute a sort of cost formula which can be followed when similar cases arise.

491. Costs in Merchandising Enterprises.— Whenever a cost accountant is asked to introduce a system whereby the proprietor will be able to know the profit or loss on each job or line of goods sold, and also to obtain a monthly balance sheet, the first question to ask is whether the business is a merchandising or manufacturing one. If the undertaking belongs to the former class, the cost accountant at once knows that the cost price of an article of merchandise can be obtained from the invoice which is received from the vendor when goods are purchased. This of course, simplifies the problem of ascertaining the gross profit or loss on sales of merchandise. In order to illustrate the method of operating a cost system in a merchandising concern, reference will be made to the forms and accounts in a trading enterprise.

492. Costs in a Trading Business.— The operation of a complete cost system in a trading enterprise will be explained in Chapter XXXIX. The business taken for illustration is one dealing in candied citron, orange, and lemon peel. Since only a few lines are han-

dled, a complete presentation of the forms and accounts in use is possible. The reader will be able to trace the operation of the system from the initial transactions up to and including the preparation of financial statements.

493. Costs in Manufacturing Undertakings.— If a cost system is to be installed in an industrial undertaking, it is necessary to ascertain whether the enterprise comes under the process or job-order class. All the so-called extractive industries are of the process type. Quarrying and mining of minerals is continuous and goes on from day to day, the cost of one ton being the same as that of another ton dug from the earth during the same period. Smelting, refining, milling, spinning, and tanning are all processes, and the cost of the product of these operations is found by the process method of accounting. But if the product is produced according to individual orders, the plant usually belongs to the job-order class. If this is the case, it is necessary for the cost accountant to determine whether the cost calculations are to be made before jobs are done or after the work of production has been finished. The usual practice in mechanical industries and assembling plants is to figure the cost of each job after it has been completed so that a record of material actually used and time spent may be available. The cost of ornamental iron work, steam engines, furniture, airplanes, and pipe organs has to be ascertained from actual records to be dependable. However, in the needle and allied industries, the cost estimates that are prepared when new samples are made are usually used as the basis of all calculations. These are often referred to as predetermined job costs, or sometimes as estimating cost systems. Estimating cost systems are found in clothing, shoe, glove, and hat factories. The kind of cost systems usually found in different industries is shown in the accompanying chart.

494. Chart Showing Kind of Cost System Usually Used in Different Industries.— In Exhibit AZ various industrial enterprises are segregated under the two general headings of continuous-process plants and job-order factories. In the former group a distinction is made between extractive and manufacturing enterprises. In mines and quarries the loss sustained by reason of the exhaustion of the natural resource from which material is extracted takes the place of the amount paid for raw material when purchased from vendors. The product of manufacturing plants of the continuous-

process class is usually made from but one kind of raw material, or from only a few kinds of material of which one kind constitutes the major portion.

Under the general head of job-order factories a division is made

AZ

CHART SHOWING KIND OF COST SYSTEM USUALLY FOUND IN DIFFERENT INDUSTRIES

Continuous Process Plants	Job Order Factories	
	Actual Costs	Estimated Costs
Extractive Minerals	Mechanical and Allied Industries	Miscellaneous Industries
Manufacturing	Foundries and Machine Shops	Hats and Caps
Butter, Cheese, Milk	Cash Registers and Calculating Machines	Fur-Felt
Canning and Preserving	Engines	Wool-Felt
Slaughtering, Meat Packing	Locomotives	Men's and Women's Clothing
Bread and Bakery Products	Ordnance	Men's and Women's Furnishings
Flour Mills	Pumps	Collars and Cuffs and Shirts
Sugar Refining	Safes and Vaults	Millinery
Confectionery and Ice Cream	Stoves and Furnaces	Boots and Shoes
Food Preparations	Typewriters	Gloves and Mittens
		Pocket Books
Cordage	Furniture and Fixtures	Saddelry
Knit Goods	Cooperage	Jewelry
Shoddy	Lasts	Artificial Flowers
Yarn		Straw Hats
	Printing	Stationery Goods
Chemicals	Book Binding	Toys and Games
Fertilizers	Lithographing	
Oils		
Paints and Varnishes	Auto Bodies and Parts	
Soap	Automobiles	
	Carriages and Wagons	
Cement	Cars	
Brick and Tile	Aeroplanes and Parts	
Glass		
	Woolen and Worsted Woven Fabrics	
Iron and Steel		
Paper and Pulp		
Leather	Musical Instruments	
Smelting and Refining	Organs, Pianos, Phonographs	

EXHIBIT AZ. CHART SHOWING KIND OF COST SYSTEM USUALLY FOUND IN DIFFERENT INDUSTRIES

between these industries in which actual costs are obtained and those in which estimated or predetermined costs prevail. The most complete job-order cost systems are found in the mechanical and allied industries. One special feature of these industries is the great vari-

ety of material used in the product, in contrast to the few kinds entering into the product of a process plant. Within the mechanical-industries group are found the so-called assembling industries, in which parts are made and subsequently assembled into the finished product.

Estimated or predetermined costs are most frequently found in the clothing and allied industries, or, as they are sometimes called, the needle industries. Nevertheless, there are other industries, as indicated in Exhibit AZ, in which estimated costs prevail.

495. **Costs in a Process Plant.**— The first complete manufacturing cost system to be described in this part of the book is taken from a continuous-process factory where prepared cocoanut is manufactured. This system is presented in order to show the relation between the cost forms and accounts in a single-process plant. Because of the simplicity of the manufacturing processes and the ease of calculating costs, the reader will have no difficulty in following the plan of cost finding from the time material is issued to the factory until the preparation of financial statements.

496. **Costs in a Job-Order Plant.**— After the explanation of a process cost system, the plan of cost finding in a job-order factory will be explained, and special reference made to costs in the job-printing industry. The individual jobs form the cost units. Printing plants are highly departmentalized, and the method of making an analysis of the expenses and amount of business done by each department is presented in detail. The plan of cost finding in use by printers is known as the "sold-hour" system, wherein the hourly cost of labor and expense is determined for various producing units and work classifications. The use of rates as a means of cost finding is clearly brought out. Costs in a job printery are actual costs, as they are prepared after the work has been performed and exact records of material used and time spent are available.

497. **Estimated Costs.**— The operation of a complete cost system in a shoe factory will be explained in order to show the method of using predetermined costs as a basis for cost work. Control is established over the estimates in such a way that any discrepancies between actual consumption and estimated requirements are shown.

498. **Textile Costs.**— The textile industry is highly specialized, and since many technical terms are used in connection with the

operations in it, a special chapter will be devoted to a description of textile costs.

499. **Silk-Mill Problem.**— The complete operation of the cost accounts in a continuous-process plant will be brought out in a problem taken from a silk-throwing mill. After studying the explanations which will be given in this part of the work, the reader should have no difficulty in calculating costs in any factory, whether of the process or the job-order type.

500. **Summary.**— This part of the book will be devoted to the presentation of several complete cost systems. The examples given are taken from both merchandising and manufacturing enterprises. The use of rates as a means of applying overhead as a burden on the product usually indicates that a job-order system is in operation.

Questions on Chapter XXXVIII

1. Distinguish between the cost problem in merchandising and manufacturing enterprises.
2. Name 10 industries in which job-order costs are usually obtained.
3. Name 10 industries in which process costs are usually found.
4. In the needle industries are costs usually calculated before the job is put in work or afterwards?
5. What kinds of costs are found in a silk-throwing mill?

CHAPTER XXXIX

COST ACCOUNTS OF A TRADING ENTERPRISE

501. Analysis of Sales.— One might at first think that a concern which purchased all the goods sold would not require a cost system. However, such is not the case, for every trading enterprise needs a system of cost accounts to keep the executive informed of the relation which selling expense bears to profits or losses in particular lines. It might be found that while the business as a whole was not profitable, it would have been so if certain lines had been discontinued or others expanded. In order to ascertain the profitableness of a business done during each month the manager of a trading concern should analyze his sale by classes, departments, lines of goods handled, and so on, according to the nature of the enterprise, and he should distinguish between gross profits and net profits in each subdivision.

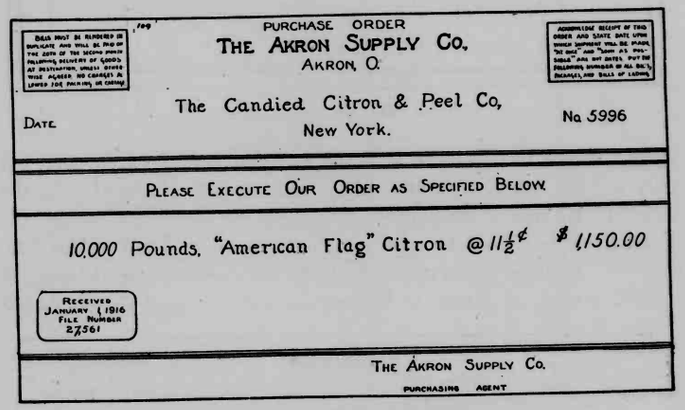
502. Gross Profit on Trading.— It is, of course, possible to find the gross profits by departments or other classifications by taking an inventory and closing the books in the usual manner. However, the introduction of the cost system to be described later enables the business man to see the relation of profits to costs on each sale immediately and it classifies the sales so that the manager is aware of the profit or loss on each line from day to day and he does not have to go blindly until yearly or semi-yearly inventory periods roll round.

503. Candied Citron and Peel Company's Accounts.— In order to explain the method of operating the accounts of a trading enterprise using the cost system we have in mind, reference will be made to the records of a concern handling candied citron and peel. This business is selected because the records, while simple in character, nevertheless illustrate the principles applicable to the handling of the accounts of any trading company. Although we will call the company by a fictitious name, the illustrations are taken from the actual records of an enterprise dealing in candied citron and peel.

There are three main features in the system of the Candied Citron

& Peel Company: (*1*) a complete analysis of sales as to cost and selling price, (*2*) a perpetual inventory of all merchandise, and (*3*) monthly financial statements.

504. Purchase Order and the Order Censor.— At the office of the Candied Citron & Peel Company "Purchase Orders," Form 104, are received at the incoming mail department, stamped "Time Received" and indexed with the customer's file number. They are then passed over to the "order censor" who translates the purchase order, if necessary, into terms understood by the house. Thus responsibility is definitely fixed for the correct interpretation of all orders.


PURCHASE ORDER
THE AKRON SUPPLY CO.
AKRON, O.

DATE

The Candied Citron & Peel Co,
New York.

No 5996

PLEASE EXECUTE OUR ORDER AS SPECIFIED BELOW

10,000 Pounds, "American Flag" Citron @ 11½¢ $1150.00

RECEIVED JANUARY 1 1916
FILE NUMBER 27561

THE AKRON SUPPLY CO.
PURCHASING AGENT

FORM 104. PURCHASE ORDER

505. Shipping Order.— Complete provision is made on the "Shipping Order," Form 105, for entering credit information so that the order can be promptly passed by the credit man. Some of the features which will be noticed are the spaces for entering the amount of teaming and freight outward so that the cost can be either billed the customer, together with the merchandise, or charged to selling expense. The original of the Shipping Order is sent to the carman who holds it until the merchandise is received from the stock clerk and shipped, after which it is checked and returned to the office.

506. Requisition.— A "Requisition," Form 106, is issued simultaneously with the Shipping Order as authority for the delivery of

RATING A 1	105 SHIPPING ORDER	No. 2725
LIMIT 5,000		TEAMING
ACCOUNT O.K.	SOLD TO The Akron Supply Co, Akron, Ohio	FREIGHT $25.00
BILLED a.B.	SHIP BY Freight FROM Stock	STOCK C.D.

CHECK	QUANTITY	UNIT	ITEM	AMOUNT
	10,000	Lbs.	Citron	$1,150
	50	Cases	American Flag	
Order No	5996			

FORM 105. SHIPPING ORDER

stock. When merchandise is stored in a number of warehouses, not only private but also public, this is a necessary safeguard. In the case of the public warehouses no goods are delivered except the Requisition be signed by a properly appointed employee of the company. The Requisition shown in Form 106, calls for the delivery of 10,000 pounds of citron to the carman for shipment to the Akron

STOCK C.D.	106 REQUISITION	No. 127
POSTED a.d.	Linde Stores	New York 1/1/1916
ISSUED BY O.F.	DELIVER TO Our Carman	
	For The Akron Supply Co.	

LOT	MARKS	QUANTITY	UNIT	ITEM	COST
1		10,000	Lbs.	Citron	$700
		50	Cases		

THE CANDIED CITRON AND PEEL CO.
By

FORM 106. REQUISITION ON STORES

Supply Company, in accordance with the terms of their purchase order. After shipment is made the Requisition is sent to the office so that the proper entries can be made on the Stock Record.

107 STOCK RECORD

ARTICLE Citron BRAND

DESCRIPTION 10 Lb. Boxes, 20. to Case

RECEIVED

DATE	NO.	QUANTITY	UNIT	PRICE	AMOUNT	
1916 Jan 1	1	29,000	Lbs.	$.07	2,032	50
Jan. 5	7	6,000	"	.06¾	405	
Jan. 8	10	40,000	"	.07¼	2,900	
Jan. 10	11	1,000	"	.07¼	72	50

DELIVERED

DATE	NAME	NO.	1	7	10	11	BAL.
1916 Jan. 2	Akron Sup. Co	1	10,000				19,000
Jan 3	A. & B. Co.	2	7,000				12,000
Jan. 4	Standard	3	12,000				0
Jan. 6	W. & B. Co.	4		5,000			1,000
Jan. 7	James & Son	5		1,000			0
Jan. 9	W. A. & S.	6			5,000		35,000
Jan. 10	Returns	92			1,000		35,000

FORM 107. STOCK RECORD

507. Stock Record.— A Stock Record card, Form 107, is used for each class of goods handled. The one illustrated shows the record of American Flag Brand citron, packed in 10-pound boxes, 20 in a case. The card shows that on January 1 there were received 29,000 pounds which cost $0.07 per pound. Then on January 2, 10,000 pounds were drawn out on Requisition 1, for the Akron Sup-

ply Company, leaving a balance on hand of 19,000 pounds. Further orders reduced the stock so that on January 4 the company was out of this class of merchandise.

508. Pricing System.— When the requisition (Form 106) was entered on the Stock Record card, the 10,000 pounds delivered were priced at the cost of $0.07 per pound, making a total cost of $700 as shown. This was also done for the citron delivered on January 3, and on January 4, at which time the supply became temporarily exhausted.

108

INVOICE

THE CANDIED CITRON & PEEL CO.
NEW YORK

TERMS
2% 10 Days
30 Days Net

Jan. 2, 19

SOLD TO The Akron Supply Co.
Akron, Ohio.

2725 SHIPPED VIA Freight

10,000	Lbs. Citron @ 11½¢	$1,150
50	Cases American Flag	25
	Freight	$1,175
Order No.	5996	

FORM 108. INVOICE TO CUSTOMER

The second lot of candied citron of this brand was received on January 5, and cost $0.06¾ per pound. The receiving number is used as the lot number and deliveries are entered in the second column and priced at the cost of $0.06¾ per pound. Reference to the card as it now stands shows a balance on hand of 36,000 pounds, which cost $0.07¼ per pound.

The advantage of this system of pricing is at once evident because the exact cost of the balance on hand can always be obtained. This method is sometimes referred to as the "lot number" system.

509. Invoice.— All shipping orders are passed to the billing clerk who makes out the "Invoice," Form 108, in duplicate. The original invoice is slipped into an "Outlook" envelope and sent to the

customer, while the duplicate one is used in posting the Sales Ledger, after which it is used in recapitulating the sales by articles sold.

510. Sales Analysis.— Daily sales are analyzed by means of the "Sales Analysis" card, Form 109. Reference to the card shows that there was but one sale of American Flag Brand citron on January 2, and that was to the Akron Supply Company, and it amounted

109 SALES ANALYSIS

ARTICLE Citron MONTH January, 19

DESCRIPTION 10 Lb. Boxes 20 to Case

Day	Sales	Returns	Net Sales
1			
2	1,150		1,150
3	805		805
4	1,380		1,380
5			
6	575		575
7	115		115
8			
9	690	115	575
10			
11			
12			
13			
14			
	4,715	115	4,600

FORM 109. SALES ANALYSIS

110 COST OF SALES ANALYSIS

ARTICLE Citron MONTH January 19--

DESCRIPTION 10 Lb. Boxes 20 to Case

Day	Cost of Sales	Cost of Returns	Net Cost
1			
2	700		700
3	490		490
4	842.50		842.50
5			
6	337.50		337.50
7	67.50		67.50
8			
9	435	72.50	362.50
10			
11			
12			
13			
14			
	2,872.50	72.50	2,800

FORM 110. COST OF SALES ANALYSIS

to $1,150. Returns are deducted when there are any and the net sales entered. The cards are footed monthly and at the end of the year a recapitulation of the year's sales is made on a summary card. A separate card is used for each kind or grade of article handled.

511. Cost of Sales Analysis.— A point especially aimed at in this simple system is to find the monthly cost of sales by classes of goods sold. Therefore, the cost on the requisition (Form 106) is also recapitulated daily on the "Cost of Sales Analysis" card, Form 110. There was but one sale of citron on January 2, and that was to the Akron Supply Co., and cost $700, as shown. If there are any returns, they are deducted in order to get the net cost of sales. The gross cost of sales for the month was $2,872.50 and the cost

of returns $72.50, making the net cost of sales for the month $2,800. The difference between this figure and the selling price on the Cost of Sales Analysis card, Form 109, of $4,600, is $1,800, which is the gross profit on sales of American Flag Brand citron, packed in 10-pound boxes, 20 to a case, for the month of January. This information is needed for every article sold in order that a detailed statement of the gross profit on sales may be made at the close of each month.

512. Analysis of Gross Profit on Sales.— The information contained on the Sales and Cost of Sales Analysis cards is used as a basis for preparing the "Analysis of Gross Profit on Sales," Form

ANALYSIS OF GROSS PROFIT ON SALES
FOR THE MONTH OF JANUARY 19.

Article	Pounds	Brand	Description	Sell'g Price		Cost		Gross Profit			
Citron	40,000	Am. Flag	10 lb. Boxes, 20 to Case	4,600		2,800		1,800			
"	6,000	" "	25 lb. Boxes	675		395		280			
"	30,000	Paragon	10 lb. Boxes, 12 to Case	3,900		2,332		1,568			
"	26,000	Eagle	10 lb. Boxes, 20 to Case	2,730		1,610		1,120			
"	20,000	"	25 lb. Boxes	2,050		1,210		840			
"	140	Pieces	70 lb. Boxes	13	30	11	30	2		5,610	
Lemon Peel	44,000	Am. Flag	10 lb. Boxes, 20 to Case	4,180		2,510		1,670			
" "	10,000	" "	25 lb. Boxes	925		558		367			
" "	660	" "	60 lb. Boxes	54	45	39	45	15			
" "	30,500	Paragon	10 lb. Boxes, 12 to Case	3,202		1,872		1,330		3,382	
Orange Peel	24,000	Am. Flag	10 lb. Boxes, 20 to Case	2,280		1,423	20	856	80		
" "	800	" "	25 lb. Boxes	75	25	45	25	30			
" "	3,000	Paragon	10 lb. Boxes, 12 to Case	315		193	80	121	20	1,008	
			Total	25,000		15,000				10,000	

FORM 111. ANALYSIS OF GROSS PROFIT ON SALES

111, at the end of each month. The gross profit on the citron is seen to be $5,610, on lemon peel $3,382, and on orange peel $1,008, making a total of $10,000, for the month of January. In the business taken for illustration there are but few brands sold, but nevertheless the same principles for analyzing sales hold good in all trading enterprises.

513. Journal Voucher.— The next step in the operation of the system herein outlined is to incorporate the information thus far obtained into the controlling accounts on the General Ledger. This is done monthly by the "Merchandise Journal Voucher," Form 112. First the entries to the Sales account are made, and then those to the Cost of Sales account. It is a fundamental principle of accounting

112 JOURNAL VOUCHER

DATE Jan. 31, 19 No.

Account	Item	Debit	Credit
	Accounts Receivable	25,915.00	
	Sales		25,915.00
	Sales	915.00	
	Accounts Receivable		915.00
	Cost of Sales	15,550.00	
	Merchandise		15,550.00
	Merchandise	550.00	
	Cost of Sales		550.00

ENTERED BY APPROVED BY

FORM 112. JOURNAL VOUCHER

for the business of a trading concern that these nominal accounts be kept separate.

GENERAL LEDGER

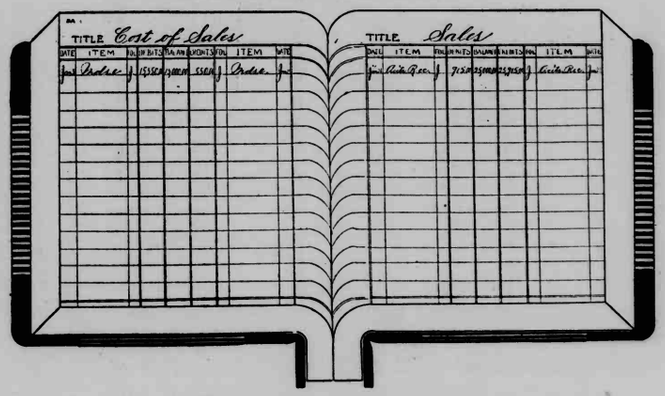


EXHIBIT BA. GENERAL LEDGER

514. **The General Ledger.**— The General Ledger of the Candied Citron and Peel Company is shown in Exhibit BA, opened at the Cost of Sales and Sales accounts. The journal vouchers have been

113

THE CANDIED CITRON & PEEL CO.
NEW YORK
GENERAL LEDGER TRIAL BALANCE
AS OF JANUARY 31, 19

NAME OF ACCOUNT	DEBIT BALANCES	CREDIT BALANCES
ASSETS		
ACCOUNTS RECEIVABLE	35,000	
BILLS RECEIVABLE	5,000	
CASH	2,250	
FURNITURE AND FIXTURES	3,000	
INSURANCE PREPAID	110	
MERCHANDISE	95,000	
REAL ESTATE	40,000	
LIABILITIES		
ACCOUNTS PAYABLE		55,000
BILLS PAYABLE		10,000
CAPITAL		75,000
DEPRECIATION RESERVE		15,000
SURPLUS		20,220
TAXES		40
LOSSES		
COST OF SALES	15,000	
SELLING EXPENSE	5,000	
GAINS		
DISCOUNTS RECEIVED		100
SALES		25,000
CLEARING		
PAY ROLL		
TOTAL	200,360	200,360

FORM 113. GENERAL LEDGER TRIAL BALANCE

all posted for the month of January and the respective balances brought down to these two nominal accounts at the close of business on January 31.

515. **Trial Balance.**— The relation which the Cost of Sales and Sales accounts bear to other accounts in the General Ledger is shown by the "Trial Balance," Form 113. The accounts appear just as

they are arranged in the General Ledger of the Candied Citron & Peel Company. The superiority of this system of handling the account will now be seen when it is attempted to prepare a financial statement without taking an inventory at the end of the first month of the new year's business.

516. **Trading and Profit and Loss Account.**— The next step is to arrange a "Trading and Profit and Loss" account from the nominal or, as they are frequently called, the economic accounts in the trial balance. This is an easy matter as shown in the following statement:

TRADING AND PROFIT AND LOSS ACCOUNT FOR JANUARY, 19—

Sales	$25,000.00
Cost of Goods Sold	15,000.00
	$10,000.00
Selling Expense	5,000.00
Gross Profit on Trading	$ 5,000.00
Discounts Received	100.00
Net Profit for January	$ 5,100.00

The profit made on trading is thus seen to be $5,000 for the month of January, to which amount has been added $100 for discounts received, making the net profit $5,100.

114

THE CANDIED CITRON & PEEL CO.
NEW YORK
BALANCE SHEET
AS AT THE CLOSE OF BUSINESS JANUARY 31, 19

ASSETS			LIABILITIES		
CURRENT ASSETS			CURRENT LIABILITIES		
CASH	2,250		BILLS PAYABLE	10,000	
BILLS RECEIVABLE	5,000		ACCOUNTS PAYABLE	55,000	65,000
ACCOUNTS RECEIVABLE	35,000	42,250			
MERCHANDISE INVENTORY		95,000	TAXES ACCRUED		40
FIXED ASSETS					
FURNITURE AND FIXTURES	3,000		CAPITAL AND SURPLUS		
REAL ESTATE	40,000		CAPITAL	75,000	
TOTAL	43,000		SURPLUS	20,220	
LESS DEPRECIATION	15,000	28,000	GAIN, JANUARY 19	5,100	25,320	100,320
INSURANCE UNEXPIRED		110			
TOTAL ASSETS		165,360	TOTAL LIABILITIES		165,360

FORM 114. BALANCE SHEET

517. **Balance Sheet.**— The remaining accounts on the trial balance are grouped under the head of either assets or liabilities on the "Balance Sheet," shown in Form 114. The surplus at the beginning of the year has been augmented by the January gain of $5,100, which now leaves the surplus account with a balance of $25,320.

518. **Summary.**— The system herein outlined shows how the accounts of a trading enterprise can be kept so as to provide for an analysis of sales to show cost and gross profit on each class of goods handled and also how financial statements may be prepared which will enable the executives to keep in close touch with the details of the business. In addition, the system of control provides for keeping a close check on the investment in stock on hand, and also on the amount of the risk which must be covered by insurance premiums.

Questions on Chapter XXXIX

1. What use can a trading concern make of cost accounts?
2. How is the gross profit on trading found?
3. What relation do the following forms have to the cost system in a trading enterprise: purchase order, shipping order, requisition, stock record, and invoice?
4. How is the analysis of the cost of sales and sales made? Give an illustration.
5. How is the Trading and Profit and Loss account prepared?

CHAPTER XL

COST ACCOUNTS IN CONTINUOUS-PROCESS FACTORIES

519. **Unit Costs.**— Process factories usually present fewer difficulties to the cost accountant than job-order plants for the reason that it is usually easier to make the apportionment of material, labor, and expense over the product. One can understand readily that in converting wheat into flour of a certain grade during a given period the average cost of one barrel is figured the same as that of another. During a month the average cost of a ton of news-print paper is the same as that of another. If production and prices of material and labor remained constant, the cost of a unit of the product made in any one month compared with that made in another would be the same. However, there is usually a variation in some or all of the factors affecting costs and so it is the best practice to close the books in process factories at least once a month and figure the cost of the product. These monthly calculations furnish the managers with a valuable index to the trend in cost prices of the product.

520. **Single and Multi-Process Factories.**— The simplest case is found in a single-process factory, making a uniform product, even if packed in different sized containers. However, it usually happens that several different products are being processed simultaneously. The entire output of one of the food-products factories may consist of but one kind of patented breakfast food, while another factory may produce a varied line of breadstuffs and fancy crackers. Many difficulties are encountered in ascertaining the cost of production in multi-process factories due to the necessity for making a proper apportionment of the labor and expense of converting raw material into the finished product.

521. **Theoretical Production.**— Where manufacturing processes are performed largely on machines which produce at a uniform rate it is quite common for accountants to make use of the "Theoretical Production" as a basis for apportioning the conversion cost. As

previously stated, in this volume the term "conversion cost" is used in manufacturing enterprises to include the expenditures for labor and expense in transforming raw material into the finished product. When several products are made simultaneously on machines with a standard rate of production, it is often necessary to use the theoretical production of the machines as the basis for apportioning the conversion cost over the product. This was the method used by the Tariff Board in figuring the conversion cost on cotton yarn used in plain goods. More will be said about this system in a subsequent chapter.

522. **Departmental Processes.**— When each process is carried on in a separate department as the dyeing, bleaching, mercerizing, or printing in a textile-finishing plant, not much difficulty is usually experienced in figuring costs. The plan consists simply in treating each department as a little business in itself. However, if the product undergoes several processes, it is necessary to add together the cost of each of these processes through which the material has passed in order to obtain the total cost of conversion. The simplest case is, of course, found in a plant having but one process to deal with. In order to illustrate the application of the principles of process cost accounting reference will be made to the forms and accounts of a prepared-cocoanut factory.

523. **Manufacture of Prepared Cocoanut.**— The prepared cocoanut manufactured in this country is known as shred, thread, desiccated, and macaroon, according to the size of the pieces of meat produced. Most of the cocoanuts come from tropical South America, and are received in New York in bags usually containing 100 nuts each. The cocoanuts are first boiled to soften the hard shell, after which they are cracked open by the opener who uses a heavy iron-handled knife. Openers get paid by piece work, the rates usually being per hundred nuts opened and shaved. A boss takes the contract at this price and pays his helpers a somewhat smaller figure. When the white meat is separated from the shell, some of the brown husk adheres to the meat and it is necessary to shave this husk off. Women and girls accomplish this work quickly by using little spoke shavers. As soon as the shaving operation has been completed, the white meat is tossed into a tub of water so the meat can be washed. After the completion of this operation the white meat is carried in an

endless conveyor to the machine operators where the white meat is dropped into the hopper of a punch press, the plunger pressing the white cocoanut meat through special dies which squeeze the cocoanut meat out into threads or shreds as the meat is now called. At this point the raw cocoanut is weighed in order to calculate the quantity of sugar, glycerine, and salt to be added to the raw meat. These ingredients are added in the proper proportion by the mixer, who heats the cocoanut in a revolving kettle that is surrounded by steam coils. After the mixing process has been thoroughly accomplished it is necessary to dry the cocoanut meat. This is done by means of an endless conveyor which carries the cocoanut over steam coils. During the passage of the cocoanut from one end of the conveyor to the other the meat is thoroughly dried and at the end of the journey it is dumped into a moving hopper which shakes the cocoanut through differently sized sieves, thereby separating the thread, shred, desiccated, and macaroon cocoanut. However, the cocoanut meat is still warm and it must be thoroughly cooled before it is ready to be packed. The cooling process takes place on long tables on which the cocoanut is spread out in great white piles. As soon as thoroughly cooled the meat is ready to be packed. Several forms of containers are used in which to pack the cocoanut meat to meet the requirements of the trade. Barrels, boxes, and pails are used. The pails frequently contain small packages, holding only a quarter or half pound of cocoanut. It is generally the practice to pay packers who put up these small packages at piecework rates.

524. **Accounting Organization.**— In order to operate the cost system in a prepared-cocoanut factory, it is necessary to divide the organization into two parts as shown in Exhibit BB. The first division of the factory for accounting purposes covers those operations necessary to prepare the raw meat. The second division covers the manufacturing operations after the sugar, salt, and glycerine are mixed with the wet meat.

The prime cost of raw meat, as shown in Exhibit BB, consists of the cost of productive labor on the one hand, and net cost of cocoanuts on the other. In figuring the cost of the cocoanuts there are certain offsets to the invoice price. In the first place there are bags, rancid nuts which are good for the manufacture of oil, together with rots and shavings, all of which have a market value. The shells

which are removed by the openers are used for fuel in the power plant. The sum of the labor and net cost of cocoanuts gives the prime cost of raw meat as shown by the chart. The prime cost of

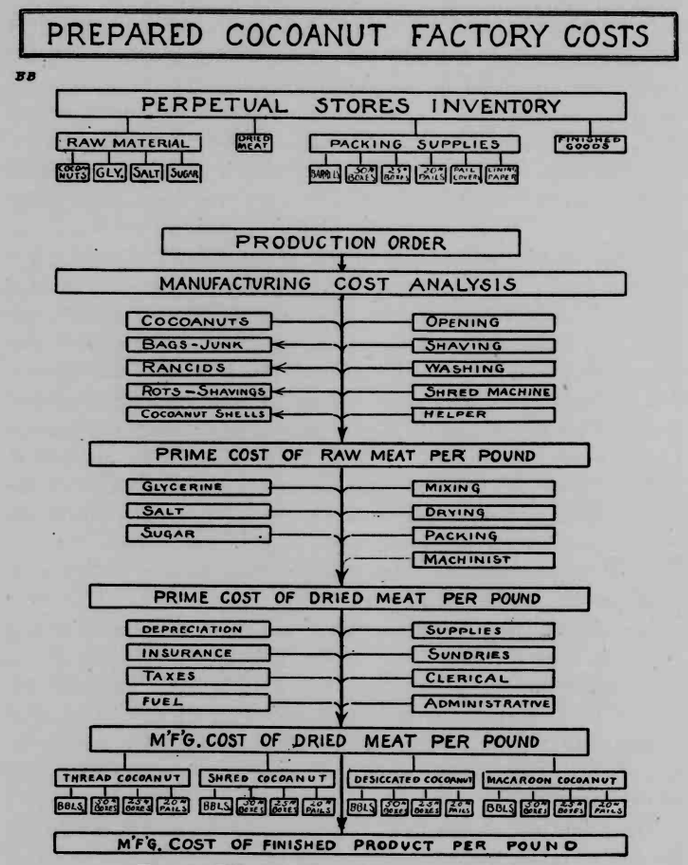


EXHIBIT BB. ACCOUNTING ORGANIZATION CHART

dried meat consists of the cost of labor for mixing, drying, packing, and for the machinist on the one hand, and of the cost of raw meat, glycerine, salt, and sugar on the other.

The next step is to add the overhead, or burden, charges to the cost of dried meat to find the manufacturing cost of dried meat. The burden charges are shown to be depreciation, insurance, taxes, fuel, supplies, sundries, clerical and administrative expense. To the cost of dried meat must be added the cost of containers, which consist of barrels, 50 and 25-pound boxes and 20-pound pails, as shown in the chart. The final result gives the manufacturing cost of the finished product per pound.

The accounting system put into operation followed the lines of the cost-system chart, Exhibit BB, as closely as possible.

525. Stores Ledger.— The raw material used in the manufacture of prepared cocoanut is brought under accounting control by the operation of a Stores Ledger (Form 57) which shows the manner of setting up a lot of 50,000 select Ruatan cocoanuts received from the steamship *Oceanic* and costing $25 a thousand or $1,250 for the lot. It being the first lot entered, the number 1 is assigned to the cocoanuts for the purpose of identification.

A special feature of the Stock Record card shown is the provision for making an entry of the quantity of cocoanuts on which the duty has been paid. In lot Number 1 duty has been paid on 25,000 cocoanuts, the balance still being in bond.

The lower part of the Stock Record card has a space for the entry of the cocoanuts withdrawn from the storeroom. There are as many vertical columns as there are horizontal lines for the various lots in the upper portion of the card. The entry which has been made shows that 10,000 of the cocoanuts on which duty has been paid have been delivered to the factory on requisition. A balance column is provided to show the inventory value of the stock on hand, which is here shown to be $1,000. At the close of each accounting period it is necessary to reconcile the inventory balances on the Stock Record cards with the balance to the Raw Material account in the General Ledger.

The form of Stock Record card which is used for supplies and finished goods is the same as the one used for raw material except that the "Paid Duty" feature is omitted. These stock cards are set up from an actual inventory, and charged for all goods received and credited for stock withdrawn from stores. The balance shows at all times the stock on hand.

526. Raw-Material Report.— It is necessary to put several reports into operation in order to obtain the necessary information for figuring costs. The first report which will be explained is known as the "Raw-Material Report," Form 115. It is usually made out by the factory clerk and contains a record of the cocoanuts opened, by-products obtained, and also the glycerine, salt, and sugar used. Reference to the Raw-Material Report will show that the select Ruatan cocoanuts entered on the stock record card appear on the report, followed by nuts from three other lots. From the gross cost of cocoanuts is deducted the value of the by-products sold or used, in order

RAW MATERIAL REPORT

DATE

RAW MEAT DEPARTMENT					DRIED MEAT DEPARTMENT				
Lot No.	Quantity	Grade	Cost per 1000	Amount	Material	Quantity	Unit	Price	Amount
1	10,000	Ruatans	$25.00	$250.00	Glycerine	100	Gal.	$.65	$65.00
25	734,000	Ruatans	25.00	18,350.00	Salt	141,500	Lbs.	.01	1,415.00
121	75,000	Culls	17.50	1,312.50	Sugar	1,200	Bbls.	4.25	5,100.00
200	143,000	Sprouts	18.50	2,645.50					
		Total		$22,558.00	Cost of Dried Meat				$6,580.00
Deductions					Cost of Raw Meat				22,129.00
200 Bags @ $.10 ea				$20.00	Total Cost				$28,709.00
11,500 Lbs Junk @ $.01 Lb				115.00					
600 Lbs. Rancids @ .02 Lb				12.00					
7,000 Lbs. Nuts and Shavings @ $.011 Lb				77.00					
5 Tons Shells @ $5 Ton				25.00	Quantity of Dried Meat Produced				428,515 Lbs
Cost Raw Meat				$22,129.00					
Quantity of Raw Meat Produced				500,897 Lbs					

FORM 115. RAW MATERIAL REPORT

to get the net cost of raw material. In addition to the cocoanuts opened, the glycerine, salt, and sugar used to give the prepared meat the proper flavor are entered in order to compute the total material going into the manufacturing departments. The material used in the factory is charged against the Work in Process account, the by-products sold against the Cost of Sales, and the by-products burned as fuel are a charge against the Burden account.

527. Payroll Distribution.— A distribution of the payroll is made on Form 116 in such a way as to show how much labor is to be charged to the raw meat, dried meat, and burden accounts. It will be noticed that the openers, shavers, washers, shred-machine operators and helpers belong to the raw-meat department. The opera-

tions of mixing, drying, packing, and the cost of a machinist are a charge to dried meat, while the superintendent and clerks are a charge to the Burden account.

PAYROLL DISTRIBUTION

FOR ENDED 19

Classification	Total	Manufacturing: Raw Meat	Manufacturing: Dried Meat	Burden
Opening				
Shaving	2,408.00	2,408.00		
Washing	80.00	80.00		
Shred Machine	452.00	452.00		
Mixing	275.00		275.00	
Drying	225.00		225.00	
Packing	330.00		330.00	
Machinist	29.00		29.00	
Helpers	20.00	20.00		
Clerks	65.00			65.00
Superintendent	85.00			85.00
Total	3,969.00	2,960.00	859.00	150.00

FORM 116. PAYROLL DISTRIBUTION

BURDEN ANALYSIS

FOR ENDED 19

Description	Amount	Total
Depreciation	25.00	
Insurance	12.00	
Taxes	5.00	42.00
Supplies	80.00	
Sundries	85.00	
Fuel	25.00	
Clerks	65.00	
Superintendent	85.00	340.00
Total		382.00

FORM 117. BURDEN ANALYSIS

528. Burden Analysis.— The burden in the cocoanut factory is shown distributed among eight items as follows: depreciation, in-

surance, taxes, supplies, sundries, fuel, clerks, and superintendent. By adding columns on the right of Form 117 additional space can be provided for each month of the year. Such a record is a valuable guide for administration purposes.

529. Manufacturing Cost Analysis.— In order to find the manufacturing cost of the product per pound for the period it is first necessary to collect all the charges against the process on the "Manufacturing Cost Analysis," Form 118. The procedure follows the lines indicated in the cost-system chart. The steps are as follows:

118

MANUFACTURING COST ANALYSIS

FOR ENDED 19

ITEM	AMOUNT	TOTAL	PRODUCTION	PER LB.
RAW MEAT DEP'T. MATERIAL	22,129.00			
" " " LABOR	2,960.00			
PRIME COST OF RAW MEAT		25,089.00	500,897 LBS	$.05
DRIED MEAT DEP'T. MATERIAL	6,580.00			
" " " , LABOR	859.00	7,439.00		
PRIME COST OF DRIED MEAT		32,528.00	428,515 LBS	$.076
BURDEN		382.00		
M'F'G. COST OF DRIED MEAT		32,910.00	428,515 LBS	$.0768

FORM 118. MANUFACTURING COST ANALYSIS

1. The prime cost of raw meat is found by adding together the material and labor in that department. Afterwards the production of raw meat in pounds is divided into the total cost of raw meat in order to find the cost per pound. This is shown to be $0.05.

2. The prime cost of dried meat is found by adding the material and labor in the dried-meat department to the prime cost of raw meat. Then the total obtained is divided by the weight of dried meat produced, and the operation gives the cost per pound of dried meat. It will be noticed by referring to Form 118 that the original quantity of 500,897 pounds of raw meat shrank to 428,515 pounds when dried.

3. The manufacturing cost of dried meat is found by adding the burden to the prime cost of dried meat. By dividing this sum by the

weight of dried meat produced the manufacturing cost per pound of dried meat is obtained.

As we are dealing with a factory of the single-process type we have now arrived at the manufacturing cost of the product, which is shown to be an average of $0.0768 per pound. All that now remains is to find the cost of the finished goods.

530. Goods Packed and Supplies Used.— As above mentioned the manufacturing cost is the same for one pound as for another. However, the type of container the goods are packed in makes a

119

GOODS PACKED AND SUPPLIES USED

FOR ENDED 19

DESCRIPTION THREAD COCOANUT	PACKED IN BARRELS			WEIGHT 110 TO 120 POUNDS	
ITEM	QUANTITY	UNIT	PRICE	AMOUNT	TOTAL
DRIED MEAT	7,600	LB.	.0768		583.68
EMPTY BARRELS	68	EA.	.35	23.80	
PAPER				.56	24.32
TOTAL					608.00
POUNDS OF DRIED THREAD COCOANUT					7,600
COST PER POUND PACKED IN BARRELS					$.08

FORM 119. GOODS PACKED AND SUPPLIES USED

difference in figuring the cost of finished goods. In order to illustrate the method of calculating the cost of the finished product reference is made to Form 119 — which shows how the cost of thread cocoanut, packed in barrels weighing from 110 to 120 pounds each, is figured.

The Cost Sheet, Form 119, shows that during the period 7,600 pounds of dried meat were packed, the cost being $0.0768 per pound, giving a total of $583.68 for the dried meat. Then 68 barrels at a cost of $0.35 each were used, and lining papers and labels costing in all $0.56 were also used. The total of the dried meat, barrels, and paper amounts to $608 as shown. The weight of dried meat divided into the total cost gives $0.08 as the cost per pound when packed in

barrels. The same procedure is followed in calculating the cost when the product is packed in boxes, cartons, and so on.

531. Cost of Sales.— It is an easy matter to figure the cost of sales when the unit costs of the various items sold are known. Reference to the "Cost of Sales," Form 120, illustrates how the tabulation is made in the cocoanut factory. The first item shows that during the period 100,000 pounds of shred cocoanut, packed in barrels, was

120

COST OF SALES

FOR ENDED 19

POUNDS									
100,000	SHRED	BARRELS		.08	8	000	00		
30,000	"	BOXES,	50 LB.	.08¾	2	624	00		
40,000	"	"	25 LB.	.09	3	600	00		
24,000	"	PAILS	20 LB.	.09¼	2	220	00	16	444 00
70,000	THREAD	BARRELS		.08	5	600	00		
40,000	"	BOXES	50 LB.	.08¾	3	500	00		
20,000	"	"	25 LB.	.09	1	800	00		
10,000	"	PAILS	20 LB.	.09¼		925	00	11	825 00
30,000	MACAROON	BOXES	50 LB.	.08¾	2	625	00		
12,300	"	"	25 LB.	.09	1	107	50		
8,000	"	PAILS	20 LB.	.09¼		925	00	4	657 50
15,000	DESICCATED	BARRELS		.08	1	200	00	1	200 00
	COST OF PREPARED COCOANUT							34	126 50
2,000	BAGS		EA	.10		200	00		
11,500	JUNK			.01		115	00		
600	RANCIDS			.02		12	00		
7,000	ROTS. SHAVINGS			.011		77	00		404 00
	TOTAL COST OF SALES							34	530 50

FORM 120. COST OF SALES

sold. The cost sheet shows the cost per pound is $0.08 which gives $8,000, the total cost for the period for this item. The same procedure is followed for the other items. The cost of prepared cocoanut sold is shown to be $34,126.50, to which must be added the estimated cost of the so-called by-products amounting to $404, which gives a total cost of sales of $34,530.50, as shown. This completes the description of the strictly cost forms and we can now proceed to take up the method of incorporating the costs into the controlling accounts on the ledger.

121

JOURNAL

DATE 19

NO	NAME	CHARGE	CREDIT
22	WORK IN PROCESS	28 709 00	
71	COST OF SALES	404 00	
82	BURDEN	25 00	
21	RAW MATERIAL		29 138 00
22	WORK IN PROCESS	3 819 00	
82	BURDEN	150 00	
81	PAYROLL		3 969 00
22	WORK IN PROCESS	382 00	
82	BURDEN		382 00
24	FINISHED GOODS	33 050 00	
22	WORK IN PROCESS		32 000 00
23	SUPPLIES		1 050 00
71	COST OF SALES	34 126 50	
24	FINISHED GOODS		34 126 50

FORM 121. JOURNAL

532. Journal.— The cost figures have to be journalized so that they may be posted to the Ledger. The general plan of procedure is as follows, and may be applied to almost any continuous-process factory:

1. The raw material consumed is charged to the Work in Process, Cost of Sales, and Burden accounts as per the stores report.
2. The payroll is distributed against the Work in Process and Burden accounts in accordance with the analysis.
3. The factory burden is charged to Work in Process.
4. The cost of goods manufactured, including the supplies used for packing, is charged to Finished Goods.
5. The finished goods sold are charged to Cost of Sales account at cost.

Reference to the Journal, Form 121, will show how the entries actually appear on the Journal sheet.

533. General Ledger Cost Accounts.— The General Ledger cost accounts appear as follows:

Raw Material

Dr.					Cr.
1	Inventory	$55,125.00	31	Returned Goods	$ 100.00
31	Purchases	27,310.00		Work in Process	28,709.00
				Cost of Sales	404.00
				Burden	25.00
			31	Balance, Inventory	53,197.00
		$82,435.00			$82,435.00
1	Balance brought down	$53,197.00			

Work in Process

Dr.					Cr.
1	Inventory	$ 1,152.00	31	Finished Goods	$32,000.00
31	Raw Material	28,709.00		Balance, Inventory	2,062.00
	Pay Roll	3,819.00			
	Burden	382.00			
		$34,062.00			$34,062.00
1	Balance brought down	$ 2,062.00			

Supplies

Dr.					Cr.
1	Inventory	$ 5,750.00	31	Finished Goods	$ 1,050.00
31	Purchase	450.00	31	Balance, Inventory	5,150.00
		$ 6,200.00			$ 6,200.00
1	Balance brought down	$ 5,150.00			

Finished Goods

Dr.					Cr.
1	Inventory	$22,973.00	31	Cost of Sales	$34,126.50
31	Work in Process	32,000.00	31	Balance, Inventory	21,896.50
	Supplies	1,050.00			
		$56,023.00			$56,023.00
1	Balance brought down	$21,896.50			

Cost of Sales

Dr.			Cr.
31	Raw Material	$ 404.00	
	Finished Goods	34,126.50	
		$34,530.00	

Payroll

Dr.					Cr.
31	Cash	$ 3,969.00	31	Work in Process	$ 3,819.00
				Burden	150.00
		$ 3,969.00			$ 3,969.00

Burden

Dr.					Cr.
31	Sundries	$ 382.00	31	Work in Process	$ 382.00

The other accounts carried on the Ledger have to do with the financial side of the transactions and it is not necessary to describe them here.

The first four accounts above illustrated are, of course, opened with an inventory as shown by the *pro forma* Ledger accounts here-

122

TRIAL BALANCE

DATE

NO	NAME	DR.	CR.
10	CURRENT ASSETS		
11	CASH	10 110 00	
12	ACCOUNTS RECEIVABLE	74 385 00	
13	INSURANCE UNEXPIRED	505 00	
20	WORKING AND TRADING ASSETS		
21	RAW MATERIAL	53 197 00	
22	DRIED MEAT	2 062 00	
23	PACKING SUPPLIES	5 150 00	
24	FINISHED GOODS	21 896 00	
30	FIXED ASSETS		
31	PLANT	100 000 00	
40	CURRENT LIABILITIES		
41	ACCOUNTS PAYABLE		90 310 00
42	NOTES PAYABLE		10 190 00
50	GENERAL LIABILITIES		
51	TAXES ACCRUED		40 00
52	DEPRECIATION RESERVE		25 000 00
53	DUTY		5 010 00
60	CAPITAL AND SURPLUS		
61	CAPITAL		120 000 00
62	SURPLUS		13 355 00
63	LOSS AND GAIN		
70	PROFIT AND LOSS		
71	COST OF SALES	34 530 50	
72	SELLING EXPENSE	10 631 00	
73	SALES		48 321 50
74	INTEREST		240 00
75	DISCOUNT		
	TOTAL	312 466 50	312 466 50

FORM 122. TRIAL BALANCE

with presented. After setting up the inventories the Journal entries on Form 121 are posted to the Ledger and the balance brought down to each account, as shown.

534. Trial Balance.— The balances to all of the accounts on the ledger, including, of course, the balances to the cost accounts above mentioned, are entered on the "Trial Balance," Form 122. It will be noticed that the accounts are arranged as they would appear on the financial statements. From this information appearing on the Trial

Balance, it is an easy matter to prepare the financial statements required.

535. **Balance Sheet.**— On the "Balance Sheet," Form 123, are exhibited the assets and liabilities, as at the close of the financial period. The form used provides for the arrangement of the assets in the order of their availability, beginning with the current assets

123

BALANCE SHEET

AS AT THE CLOSE OF BUSINESS 191

ASSETS		LIABILITIES	
CURRENT ASSETS		CURRENT LIABILITIES	
CASH	10 110 00	ACCOUNTS PAYABLE	90 310 00
ACCOUNTS RECEIVABLE	74 385 00	NOTES PAYABLE	10 190 00 100 500 00
INSURANCE UNEXPIRED	505 00 85 000 00		
WORKING AND TRADING ASSETS		GENERAL LIABILITIES	
RAW MATERIAL	53 197 00	TAXES ACCRUED	40 00
DRIED MEAT IN PROCESS	2 062 00	DUTY	5 010 00 5 050 00
PACKING SUPPLIES	5 150 00		
FINISHED GOODS	21 896 00 82 305 00	CAPITAL AND SURPLUS	
FIXED ASSETS		CAPITAL	120 000 00
PLANT	100 000 00	SURPLUS 13 355 00	
LESS DEPRECIATION	25 000 00 75 000 00	PROFIT 3 400 00	16 755 00 136 755 00
TOTAL ASSETS	242 305 00	TOTAL LIABILITIES	242 305 00

FORM 123. BALANCE SHEET

and ending with the fixed assets. On the liability side of the Balance Sheet appear the current and general liabilities followed by the capital and surplus. It will be noticed that the gain for the period amounts to $3,400, which corresponds to the amount shown on the Loss and Gain accounts.

536. **Profit and Loss Accounts.**— The balance to the accounts representing either losses or gains are set up as a Profit and Loss account, shown by Form 124. The cost of sales is deducted from the sales to compute the gain on the manufacturing operations, which is shown to be $13,791. Selling expense is next deducted

from the gain on manufacturing to find the gain on trading, which appears to be $3,160. To this figure the balance to interest and discount is added in order to get the net gain, which is $3,400, and this agrees with the loss and gain figure on the Balance Sheet. The Profit and Loss account as set up does not show on which specific

124

PROFIT AND LOSS ACCOUNT

FOR ENDED 19

SALES	48 321 50
COST OF SALES	34 530 50
GAIN ON MANUFACTURING	13 791 00
SELLING EXPENSE	10 631 00
GAIN ON TRADING	3 160 00
INTEREST AND DISCOUNT	240 00
NET PROFIT, PER BALANCE SHEET	3 400 00

FORM 124. PROFIT AND LOSS ACCOUNT

items the gain is made and so a supplementary statement called an "Analysis of Sales," Form 125, is prepared.

537. **Analysis of Sales.**— The "Analysis of Sales," Form 125, shows the selling price, cost, and gain resulting on each item sold during the period. The figures in the column headed "selling price" are obtained from a recapitulation of the daily sales according to class of goods sold. Costs are obtained from the Cost of Sales (Form 120). Subtracting the cost figures from the selling price gives the gain as shown. Attention should be called to the fact that on the by-products neither loss nor gain is shown.

538. Selling Expense.— The last chart to which reference will be made in the explanation of this continuous-process factory is the "Analysis of Selling Expense," Form 126. It will be noticed that there are 12 subdivisions of the selling and expense account for the

125

ANALYSIS OF SALES

FOR ENDED 19

POUNDS	DESCRIPTION	SELLING PRICE	COST	GAIN
100,000	SHRED BARRELS	11 500 00	8 000 00	3 500 00
30,000	" BOXES 50 LB.	3 675 00	2 624 00	1 051 00
40,000	" " 25 LB.	5 000 00	3 600 00	1 400 00
24,000	" PAILS 20 LB.	3 060 00	2 220 00	840 00
70,000	THREAD BARRELS	8 050 00	5 600 00	2 450 00
40,000	" BOXES 50 LB.	4 900 00	3 500 00	1 400 00
20,000	" " 25 LB.	2 500 00	1 800 00	700 00
10,000	" PAILS 20 LB.	1 275 00	925 00	350 00
30,000	MACAROON BOXES 50 LB.	3 675 00	2 625 00	1 050 00
12,300	" " 25 LB.	1 537 50	1 107 50	430 00
8,000	" PAILS 20 LB.	1 020 00	925 00	95 00
15,000	DESICCATED BARRELS	1 725 00	1 200 00	525 00
	PREPARED COCOANUT	47 917 50	34 126 50	13 791 00
2,000	BAGS	200 00	200 00	
11,500	JUNK	115 00	115 00	
600	RANCIDS	12 00	12 00	
7,000	ROTS, SHAVINGS	77 00	77 00	
	BY PRODUCTS	404 00	404 00	
	TOTAL	48 321 50	34 530 50	13 791 00

FORM 125. ANALYSIS OF SALES

period. The total agrees with the amount on the loss and gain statements.

539. Summary.— From the foregoing description of the forms and accounts kept in a continuous-process factory one will obtain a clear idea, not only of the relation of one form to another, but also of the various cost records kept and the General Ledger cost accounts, together with the financial statements. The main features of any process cost system are the provisions made for the control of the inventory and the analysis of the cost. The system must show the amount invested in the inventory as a means of making up financial statements and the unit cost of manufacture for administration purposes.

126

SELLING EXPENSE

FOR ENDED 19

NO	DESCRIPTION	DETAIL	TOTAL
1	ADVERTISING		1 010 00
2	DEPRECIATION		40 00
3	ENTERTAINMENT		300 00
4	INSURANCE		25 00
5	NO. CHARGE SALES		220 00
6	OFFICE SALARIES, PART		3 600 00
7	POSTAGE		175 00
8	PRINTING		900 00
9	REPAIRS		1 200 00
10	TRAVELING		2 800 00
11	TELEPHONE AND TELEGRAPH		90 00
12	UNCLASSIFIED		270 00
	CLUB DUES	100 00	
	SUBSCRIPTION	40 00	
	CHRISTMAS PRESENTS	30 00	
	TOTAL		10 631 00

FORM 126. SELLING EXPENSE

QUESTIONS ON CHAPTER XL

1. What sort of cost system is best adapted to meet the needs of a factory producing prepared cocoanut?
2. What processes do cocoanuts pass through during the manufacturing operations?
3. What is the cost formula for prepared cocoanut?
4. How is the cost of raw meat obtained?
5. How is the cost of dried meat calculated?
6. How is the cost of the finished product found?
7. What function does the Stores Ledger serve in a prepared-cocoanut factory?
8. What purpose is served by the following forms: raw-material report, payroll distribution, burden distribution, cost analysis, record of goods packed and supplies used, and cost of sales sheet?
9. What Journal entries are required to close the books?
10. What financial and cost statements are prepared?

CHAPTER XLI

COST ACCOUNTS IN JOB-ORDER FACTORIES

540. Mechanical Products.— Job-order factories are for the most part highly organized. That is, they are divided into different departments, each of which is equipped with special machinery for performing certain processes. The best example of job-order factory organization is found in machine shops, which are spoken of collectively as the mechanical industry. The operations in the mechanical industry largely consist of cutting, sawing, drilling, boring, tapping, planing, shaping, turning, milling, screw-machine work, fabricating, assembling, erecting, and so on. If the product is not too heavy, the material is conveyed from one set of machines to another until all the manufacturing operations have been completed on a part. Parts are assembled into sub- or partial assemblies and these are erected into the complete product. The finished product may be a phonograph, automobile, "Caterpillar" tractor, or typewriter.

541. Miscellaneous Jobbing Plants.— The job-order system of manufacture is found in a less highly organized form in lithographing, paper box, barrel, and in both printing and binding establishments. Each of these industries has operations peculiar to itself, but in no case are they as complex as in a large machine shop. The raw material required for each job must be selected and cut to the proper size. Then the specifications for the job, designs for boxes, copy for printers, and so on must be followed in executing the work. The problem of ascertaining the cost of a barrel, box, or book is about the same in one case as in another. A complete understanding of the plan of cost finding in a typical job-order factory will enable one to operate a cost system under the conditions found in almost any job-order plant. The salient difference between the method of cost finding in two job-order factories where a complete system is in operation, is in the method of applying overhead to jobs.

542. Job-Printery Costs.— In order to illustrate the application of the principles of job-order cost accounting, reference will be made at length to the plan of procedure followed in a large-sized job-printing establishment. Job-printing plants are organized along very much the same lines. Paper is cut; compositors set the type either by hand or by machine; printing is done on presses; and in the bindery the jobs are assembled and prepared for shipment. What a printer really does is to sell stock and the services of the cutting, composition, press, bindery, and other departments to his customers. Since the charges made for the finished product exceed the cost of stock and departmental services, including selling expense, the business is profitable. It is, therefore, readily understood to be of fundamental importance that the cost system be devised in such a way that the proprietor of a job-printing establishment will know at the end of each month whether or not each department has been run at a profit, and also the cost of each job shipped, together with the profit on it. All the forms and accounts required by a printer to obtain the desired results will be explained in this chapter.

543. "Sold-Hour" System of Costs.— The general plan of accounting is along the lines recommended by the American Printers' Cost Commission. The salient feature of this cost system is the method of calculating the departmental hourly costs and in assessing the cost on various jobs which are produced in the plant. The plan is known as the "sold-hour" method and was explained in a preceding chapter in connection with methods for distributing overhead expense. In a correspondence-study course, entitled "Bookkeeping and Cost Finding for Printers," given by the Extension Division of the University of Wisconsin, the method is called the "chargeable-hour" system. Whether designated as the sold-hour, chargeable-hour, or productive-hour method the plan is the same in all cases and consists in first departmentalizing all direct labor and expense after which the departmental totals are divided by the number of hours spent on work directly chargeable to customers. The result obtained is the cost per hour of service to be charged each job, depending upon the time it took to come through a department. The routine of finding the cost per sold hour as well as the method followed in figuring the job cost and in keeping the accounts will be readily understood from the descriptions of the forms and records which follow.

544. Printer's Estimate Sheet.— The job-printing business differs from a good many industries in that it is the customary practice for a printer to submit an estimate to the customer on all new work. An "Estimate Sheet" such as shown in Form 127 is generally used

127

ESTIMATE SHEET

DATE _____ NO. _____
CUSTOMER
NUMBER OF COPIES
DESCRIPTION

ITEM	UNIT	DETAIL	AMOUNT
PAPER			
INK			
BURDEN @			
CUTTING			
RULING			
COMPOSITION			
JOB PRESS 10X15			
" " 14X22			
CYLINDER PRESS A			
" " B			
BINDERY			
OUTSIDE			
SELLING EXPENSE			
PRICE TO CHARGE			

SHIPPING INSTRUCTIONS:

FORM 127. ESTIMATE SHEET

to make the estimate. In making his estimate the printer first enters the cost of paper and ink stock in the item column. To the cost of stock a burden of say 10 per cent is usually added, in accordance with the recommendations of the Cost Commission. Next the estimated time that it will take each department to do the necessary work on the job is entered and extended at the proper hourly rate, these en-

tries representing the cost of service rendered by each department. Lastly the proper percentage is added to cover selling and profit in order to find the price to charge the customer. It is necessary to have the estimate made in detail so that it can be compared with the actual production costs to see which items in the estimate have been exceeded.

545. Production Order.— If the customer accepts the printer's bid for the work, it is necessary to prepare a "Production Order" (Form 11), so that the factory will know what is wanted. The order shown in Form 11 is of the envelope style with space provided on its

128

REQUISITION

DATE Jan 2, 1918 NO. 1

QUANTITY	UNIT	DESCRIPTION	PRICE	AMOUNT
6½	Rm	No. 2. Enamel 25X38 100 lbs	$ 6.35	$ 40 63
3 1/10	"	Rembrandt Gum 20 X 25 100 lbs.	6.50	20 15
				$ 60 78

JOB NO. 5 | ENTERED J.S. | APPROVED B. Jones

FORM 128. REQUISITION

face for full particulars about the job while the copy can be put inside for reference and to prevent its separation from the Production Order. The envelope also provides a place to keep a sample of the finished job for reference in case a repeat order is received. The Production-Order envelopes should be filed by job number and a cross index of them kept by customers' names.

546. Stores Requisition.— After the superintendent of a printing factory receives a production order he should make out a "Requisition," Form 128, for the purpose of drawing the necessary stock from the store-room. The Requisition shows the quantity of each item of stock drawn so that it can be extended at the cost price to obtain the amount to charge the job number shown in the lower left-

hand corner. At the close of each accounting period the stores requisitions are summarized and entered on a journal voucher, which will be explained in a subsequent section of this chapter.

547. Compositor's Daily Time Ticket.— We are now ready to take up the matter of keeping a record of how each of the employees in the factory spends his time. When working on customers' orders employees charge their time to production-order numbers and the time thus charged is spoken of as being productive. All time not chargeable to a regular production-order number must be charged to some expense classification, wherefore such time is called non-charge-

DAILY TIME TICKET
COMPOSITION

EMPLOYEE _____ CLOCK NO _____ DATE _____ 19

JOB NUMBER	NAME OF CUSTOMER	SYM.	TIME STARTED	TIME FINISHED	PRODUCTIVE HOURS	NON-PROD. HOURS

FOREMAN

FORM 129. DAILY TIME TICKET, COMPOSITION DEPARTMENT

able or non-productive. Throughout the time-keeping system this distinction is observed. Daily sheets are used to keep a record of how each employee spends his time, and the sheet used by compositors is shown in Form 129. One of these time sheets is given to each compositor every day so that he can record the time he starts and the time he finishes each job. The time spent on work for customers is extended into the column headed "Productive Hours" and the time on work not chargeable to customers is extended into the column headed "Non-Productive Hours." The back of the time ticket is printed with a numbered list of various kinds of work done in the department. It is intended that the compositor will refer to this

list and record the classification number of the kind of the work done in the column headed "Symbol." All time entered in the "Productive Hours" column has to be posted to the cost sheets, one of which is kept for each job. The total hours worked are entered on the payroll of the compositor's department as will be explained later.

548. Pressroom Daily Time Ticket.— Records used in the various departments of a job printery to keep the time of jobs differ in design and so the ticket used in the pressroom is illustrated in Form 130. In this instance it is necessary to keep a record of the time of

DAILY TIME TICKET
PRESSROOM

PRESS A DATE _____ 19

JOB NO.	FOR WHOM	PRESSMAN	CLOCK NO.	FEEDER	CLOCK NO.	IMPRESSIONS	WORK HRS.	PAGES	SYM.	TIME STARTED	TIME FINISHED	PROD. HOURS	NON-PROD. HOURS

FOREMAN

FORM 130. DAILY TIME TICKET, PRESSROOM

the presses rather than that of the employees. Productive time is the duration of "make-ready" and "running" time. A statistical column provides space for the number of impressions. By dividing the total impressions by the hours spent in running the press on the job, the number of impressions per hour is obtained readily. It is important that this data be kept for the benefit of the management so that a comparison can be made between actual performance and that expected from the presses. When idle time occurs, the causes should be noted. The same distinction is made between productive and non-productive time in both the pressroom and the composition department. The productive press hours are posted to the cost sheets for the individual jobs.

549. Bindery Daily Time Ticket.— Still another variation in the design of time tickets is one devised for use in the bindery, as shown in Form 131. Provision is made for the entry of the piece-workers' earnings. The same distinction is here made between productive and non-productive hours as before. Productive hours are posted to the job cost sheets.

550. Payroll.— The successive steps necessary to prepare payrolls in a printing establishment can now be taken up. A separate payroll should be prepared for each department. The one for the

DAILY TIME TICKET
BINDERY

EMPLOYEE _____ CLOCK NO _____ DATE _____, 19

Job No	Name of Customer	Pages	Sym	Quantity	Piece Work Rate	Piece Work Amount	Time Started	Time Finished	Prod Hours	Non-Prod Hours

FOREMAN

FORM 131. DAILY TIME TICKET, BINDERY

compositors is shown in Form 132. The hours that each compositor worked are obtained from the Compositor's Daily Time Ticket, Form 129. It will be noticed that under the column headings for the days of the week, provision is made to enter the productive and non-productive hours separately. At the end of the week the payroll is cross-footed as shown to obtain the total productive and non-productive hours. At the foot of the payroll form space is provided for the entry of certain statistics needed for administrative purposes, such as the ratio of non-productive labor to the total payroll. The form used for the payroll of the composition department of a job printery is suggestive of the forms used in other than press departments.

PAY ROLL

COMPOSITION DEP'T. WEEK ENDING _____ 19

Clock No.	Name	Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Total Prod Hours	Total Non-P Hours	Rate	Total Amount	Cost of Non-P Hours
		Prod	Non-P	Prod	Non-P	Prod	Non-P	Prod	Non-P	Prod	Non-P	Prod	Non-P					

TOTAL COMPOSITION DEP'T. PAY ROLL _____ AVERAGE PAY ROLL PER PROD. HOUR _____
TOTAL PRODUCTIVE HOURS _____ RATIO OF NON-PROD. TO TOTAL PAY-ROLL _____

FORM 132. PAYROLL, COMPOSITION DEPARTMENT

551. Monthly Record of Productive and Non-Productive Hours.— A recapitulation of the productive and non-productive hours is made daily for each department (except the press room) and entered on Form 133. At the end of the month the various columns on the sheet are footed to obtain the total productive and non-productive hours for each department shown. The aggregate hours reported

MONTHLY RECORD OF PRODUCTIVE AND NON-PRODUCTIVE HOURS

FOR MONTH OF 19

Date	Cutting		Ruling		Composition		Bindery-A		Bindery-B		Bindery-C		Bindery-D		Date
	Prod	Non-P	Prod	Non-P	Prod	Non-P	Prod	Non-P	Prod	Non-P	Prod	Non-P	Prod	Non-P	

FORM 133. MONTHLY RECORD OF PRODUCTIVE AND NON-PRODUCTIVE HOURS

must, of course, agree with the total number of hours appearing on the payrolls for the corresponding period. The record of productive hours is needed in order to compute the hourly rates with which to figure the cost of work done in each department. This record is a valuable administrative guide because it enables the proprietor to see at a glance whether the productive or non-productive hours are increasing. The proprietor is always striving to decrease the amount

134

MONTHLY RECORD OF PRODUCTIVE AND NON-PRODUCTIVE HOURS AND PRESS IMPRESSIONS

FOR THE MONTH OF 19

DATE	PRESS A					PRESS B					PRESS C				
	MAKE READY	RUNNING	IMPRESSIONS	NON-P.	IDLE	MAKE READY	RUNNING	IMPRESSIONS	NON-P.	IDLE	MAKE READY	RUNNING	IMPRESSIONS	NON-P.	IDLE

FORM 134. MONTHLY RECORD OF PRODUCTIVE AND NON-PRODUCTIVE HOURS AND PRESS IMPRESSIONS

of non-productive time and therefore any slight increase should be investigated.

552. Monthly Record of Productive and Non-Productive Hours and Press Impressions.— A separate record, shown in Form 134, is used for the pressroom. It serves the same purpose for the pressroom that the one previously described does for the other departments. Each press is designated by a different letter or number and under each of these is a column in which to record the productive time spent on the "make-ready" and in running, number of impressions, non-productive and idle time, as shown. The necessary information to fill in this form is obtained from the Pressroom Daily Time Ticket (Form 130), by the use of which the proprietor knows exactly how many sheets are printed each running hour. This is a valuable administrative record because it shows where leaks occur.

135

ANALYSIS OF HOURLY SERVICE COSTS

FOR MONTH OF 19

DESCRIPTION	GENERAL	STOCK	CUTTING	RULING	COMPOSITION	JOB PRESS 10 x 15	JOB PRESS 14 x 22	CYL. PRESS A	CYL. PRESS B	BINDERY	OUTSIDE	SELLING	TOTAL
SUPPLIES ISSUED FROM STORES		100.00	200.00	100.00	35.00	50.00	100.00			50.00		100.00	500.00
NON-PRODUCTIVE LABOR		3,005.50	1,996.00	2,065.00	51.00	2,960.00	3,748.50	457.00	1,361.50	1,023.00	332.50	16,599.50	33,309.50
BAD DEBTS												1,000.00	1,000.00
DEPRECIATION		10.00	25.00	100.00	40.00	500.00	550.00	600.00	625.00	50.00			2,500.00
INSURANCE		45.00	10.00	20.00	80.00	60.00	70.00	100.00	105.00	10.00			500.00
POWER			250.00	225.00		700.00	750.00	1,000.00	1,050.00	25.00			4,000.00
RENT		1,447.00	960.00	993.00	24.00	1,425.00	1,808.00	220.00	655.00	473.00	1,500.00	9,500.00	
TAXES		90.00	20.00	40.00	160.00	120.00	140.00	300.00	210.00	20.00		9,000.00	9,000.00
ADVERTISING	947.00										400.00		947.00
INTEREST													400.00
LEGAL													500.00
POSTAGE	500.00			5.00		1,800.00	10.00	1,512.00	21.50				3,318.50
REPAIRS				100.00	75.00		50.00	200.00		50.00			500.00
SPOILED WORK	1,000.00		25.00										1,000.00
STATIONERY	975.00												975.00
TELEPHONE					200.00								200.00
TYPE	50.00												50.00
WATER	9,478.00	4,407.50	3,306.00	344.00	665.00	7,600.00	7,772.50	4,389.00	4,028.00	1,700.00	332.50	28,500.00	63,932.00
SUB-TOTAL		262.50	714.00	192.00	35.00	440.00	372.50	231.00	212.00	90.00	17.50	1,500.50	
GENERAL		4,850.00	3,410.00	3,840.00	700.00	8,000.00	7,550.00	4,420.00	4,240.00	1,790.00	350.00	30,000.00	86,676.50
TOTAL EXPENSE		3,203.50	3,119.00	2,112.00	3,400.00	4,676.00	4,392.00	6,021.00	7,024.00	3,100.00	350.00	30,000.00	59,724.50
PRODUCTIVE LABOR		8,053.50	5,522.00	5,953.00	4,100.00	12,676.00	11,942.00	5,821.00	5,335.00	4,890.00			
TOTAL EXP. AND LAB.			472.00	472.00	7.68	172.12	1,615.5	2431	2,272	720.0			
PRODUCTIVE HOURS			14.20	14.20	7.56	11.73	11.03	12.35	12.33	7.68			
COST PER PROD. HOUR			11.74	11.24									
RAW MATERIAL USED		34,320.00									46.00		
% STOCK EXP. TO R.M.		22.									7.6		
OUTSIDE WORK												152,724.50	
% TO COST OF OUT. WORK													
COST OF GOODS SOLD												20	
% SELLING EXP. TO COST OF GOODS SOLD													

FORM 135. ANALYSIS OF HOURLY SERVICE COSTS

553. Analysis of Hourly Service Costs.— As stated in the first part of this chapter the plan of cost finding used by job printers is to charge each job for the service rendered by the different productive departments on the basis of a rate per productive hour. In order to determine what rates to use in charging jobs for service it is necessary to make an "Analysis of Hourly Service Costs," as shown by Form 135. The entire expenses of the business are distributed by departments. The various columns are then footed. The amount in the first column headed "General" is then prorated to the other departments on a percentage basis as shown. The sum of the direct charges to any department and the share of general expense gives the total expense. To this must be added the productive labor in order to ascertain the total cost of operating each department for the period. The next step is to find the cost per productive hour, to be used as a basis for distributing the various departmental costs to the different jobs. Thus, for example, the cost of operating the composition department for the period is shown to be $0.56 per hour. This is the figure to use in charging jobs for the time compositors work on each. If a compositor works on a job 10 hours, the cost of composition is therefore $5.60. The expense of the stockroom is best disposed of as a percentage of the value of stock issued to the factory during the period. Also the expense of having work done on the outside should be apportioned on the basis of the cost of work done. It is optional whether selling expense be distributed on the basis of the cost of production or on the sales. The method decided upon as the best will determine how the rate to be used must be calculated. We are now prepared to take up the next step which is the figuring of the cost for a job.

554. Individual Order Cost.— The cost sheet used for each order is illustrated in Form 25, in which spaces are provided under each operating department for posting the time spent by operatives on the job, except in the case of press work, in which the press number is entered instead of the employee's name. After the job is finished the productive hours entered under each departmental heading are footed. The cost of the job is then found by extending the hours by the rates previously determined for the cost of service. The cost of the stock used plus the expense of handling it, of services rendered on the job by each department, of outside work, and of selling expense make up

the grand total cost of the job as shown. Provision is made on the cost sheet for a comparison between the cost and the original estimate so that any discrepancies can be seen readily. The estimate is entered in the column headed "Selling Price" next to the cost column. We can now turn our attention to the bookkeeping procedure required to incorporate all the cost figures into the General Ledger.

555. Inventory of Work in Process.— In order to open the books in a job printery it is necessary to take an inventory. As far as the raw material is concerned no special forms are required. However, when it comes to the inventory of work in process of manufac-

136

INVENTORY OF WORK IN PROCESS

DATE

No	Description	Stock	Cutting	Ruling	Composition	Job Press	Cyl. Press	Bindery	Outside	Total

SUPERINTENDENT

FORM 136. INVENTORY OF WORK IN PROCESS

ture a special form is required. The sheet used is shown in Form 136. The information contained on this form is necessary for the purpose of opening the Manufacturing account on the General Ledger. In case a new system is being started the information contained on the Inventory of Work in Process sheet furnishes the data needed to open the individual-order cost sheets in the Cost Ledger.

556. Journal Vouchers.— One special feature of this system is the provision made for making the necessary Journal entries to incorporate all cost figures into the General Ledger accounts. Special forms are provided that no entry will be overlooked. When the proper form has been filled in and initialed by the cost accountant it

becomes a "Journal Voucher" ready for posting to the Ledger by the bookkeeper. There are a number of these vouchers required to operate a printer's cost system and so they will be explained in detail.

557. Stores Distribution Journal Voucher.— At the end of each accounting period it is necessary to make a summary of all stores requisitions in order that a "Stores Distribution Journal Voucher," Form 137, may be prepared. Charges are made to the Manufactur-

137

STORES DISTRIBUTION JOURNAL VOUCHER

DATE

DEPARTMENT	MANUFACTURING Dr.	BURDEN Dr.	SUNDRIES Cr.
STOCK	36,320	10	
CUTTING		20	
RULING		100	
COMPOSITION		35	
JOB PRESS 10 X 15		35	
JOB PRESS 14 X 22		50	
CYLINDER PRESS A		100	
CYLINDER PRESS B			
BINDERY		50	
OUTSIDE			
SELLING		100	
GENERAL			
RAW MATERIAL			36,320
SUPPLIES			500
TOTAL	36,320	500	

SUMMARY OF STORES REQUISITIONS FOR JANUARY 19

FORM 137. STORES DISTRIBUTION JOURNAL VOUCHER

ing and Burden accounts for raw material and supplies, as shown. *Pro forma* entries are made as they would appear in actual practice. The reason for entering the supplies chargeable to burden in detail is to show the amount chargeable to each department. This part of the accounting procedure is necessary to facilitate making up the Analysis of Hourly Service Costs (Form 135).

558. Labor Distribution Journal Voucher.— A summary of the departmental payrolls, such as shown in Form 138, for each accounting period is necessary to properly clear the payroll account. The footings of the Manufacturing and Burden accounts are charged to the corresponding Cost accounts on the General Ledger. The reason that the total amounts are itemized by departments is to furnish information needed in making up the Analysis of Hourly Service Costs. The statistical column is introduced to show the productive hours

138

LABOR DISTRIBUTION JOURNAL VOUCHER

DATE

DEPARTMENT	HOURS	✓	MANUFACTURING Dr.	✓	BURDEN Dr.	✓	PAY ROLL Cr.
STOCK			3,203.50		3,005.50		
CUTTING	7,250		3,312		1,996		
RULING	4,800		2,112		2,065		
COMPOSITION	7,368		3,400		51		
JOB PRESS 10 X 15	17,212		4,676		2,960		
JOB PRESS 14 X 22	11,615		4,392		3,748.50		
CYLINDER PRESS A	2,431		1,201		457		
CYLINDER PRESS B	2,292		1,094		1,361.50		
BINDERY	7,200		3,100		1,023		
OUTSIDE					332.50		
SELLING					16,509.50		
GENERAL							
TOTAL		✓	26,490.50	✓	33,309.50	✓	60,000

CLEARING PAY ROLLS 1, 2, 3, AND 4 FOR JANUARY, 19

FORM 138. LABOR DISTRIBUTION JOURNAL VOUCHER

in the various departments of the printery because this information is also required in preparing the Analysis of Hourly Service Costs.

559. Sundry Accounts Journal Voucher.— A "Sundry Accounts Journal Voucher," Form 139, is used for making entries that originate in the bookkeeping department during each accounting period. A charge to burden is made to cover bad debts, depreciation,

137

SUNDRY ACCOUNTS JOURNAL VOUCHER

DATE

DESCRIPTION	DETAIL	✓	BURDEN Dr.	✓	SUNDRIES Cr.
BURDEN			18,500		
BAD DEBTS					1,000
DEPRECIATION					2,500
INSURANCE					500
POWER					4,000
RENT					9,500
TAXES					1,000

CHARGING BURDEN FOR SUNDRY EXPENSES

FORM 139. SUNDRY ACCOUNTS JOURNAL VOUCHER

insurance, power, rent, and taxes. These items are distributed to the various departments in the printery as shown on the Analysis of Hourly Service Costs.

560. Burden Distribution Journal Voucher.— The burden for the period must be charged to the manufacturing and selling departments as shown by Form 140. This entry clears the Burden account at the end of each accounting period. The method of making the entries will be explained in more detail in a subsequent section of this chapter when the Ledger accounts are shown.

140

BURDEN DISTRIBUTION JOURNAL VOUCHER

DATE

DEPARTMENT	MANUFACTURING Dr.	✓	SELLING Dr.	✓	BURDEN Cr.
STOCK	4,850				
CUTTING	3,480				
RULING	3,840				
COMPOSITION	700				
JOB PRESS 10 X 15	8,000				
JOB PRESS 14 X 22	7,550				
CYLINDER PRESS A	4,620				
CYLINDER PRESS B	4,240				
BINDERY	1,790				
OUTSIDE	350				
SELLING			30,010		
TOTAL	39,420	✓	30,010	✓	69,430 ✓

CLEARING BURDEN ACCOUNT FOR JANUARY 19

FORM 140. BURDEN DISTRIBUTION JOURNAL VOUCHER

561. Production Journal Voucher.— It is necessary to prepare a summary of production costs at the end of each accounting period and to incorporate them into a "Production Journal Voucher," as shown by Form 141. The cost of orders for customers is a charge to production of finished goods and the cost of spoiled work is a charge to burden. The cost of production is obtained from the individual-order cost sheet, Form 25, and the charge to Burden is distributed to the different manufacturing departments on the Analysis of Hourly Service Costs.

562. Cost of Sales Journal Voucher.— The cost of goods sold is a credit to the Production of Finished Goods account when the goods are shipped. If raw materials or supplies are sold, the respective accounts must, of course, receive the proper credit. The individual

141

PRODUCTION JOURNAL VOUCHER

DATE

DEPARTMENT	PRODUCTION Dr.	✓	BURDEN Dr	✓	MANUFACTURING Cr
STOCK	59,850				
CUTTING	8,280		25		
RULING	5,280		100		
COMPOSITION	2,500		75		
JOB PRESS 10 X 15	11,690				
JOB PRESS 14 X 22	11,480		50		
CYLINDER PRESS A	6,060		200		
CYLINDER PRESS B	5,680				
BINDERY	5,300		50		
OUTSIDE	4,600				
SELLING					
GENERAL					
TOTAL	120,720	✓	500	✓	121,220 ✓

SUMMARY OF PRODUCTION COSTS FOR JANUARY 19

FORM 141. PRODUCTION JOURNAL VOUCHER

amounts in the column headed "Cost of Sales" are posted in the Ledger to the various departmental loss and gain accounts which will be shown later. The "Cost of Sales Journal Voucher" is shown in Form 142.

563. Sales Distribution Journal Voucher.— The sales are a charge to Accounts Receivable and a credit to the respective depart-

142

COST OF SALES JOURNAL VOUCHER

DATE No

DEPARTMENT	COST OF SALES Dr	✓	PRODUCTION Cr	✓	SUNDRIES Cr
STOCK	59,850		59,850		
CUTTING	8,280		8,280		
RULING	5,280		5,280		
COMPOSITION	2,500		2,500		
JOB PRESS 10 X 15	11,690		11,690		
JOB PRESS 14 X 22	11,480		11,480		
CYLINDER PRESS A	6,060		6,060		
CYLINDER PRESS B	5,680		5,680		
BINDERY	5,300		5,300		
OUTSIDE	4,600		4,600		
SELLING	30,010				
RAW MATERIAL					700
SUPPLIES					20
SELLING EXPENSE					30,010
TOTAL	150,730		120,000		

DISTRIBUTION OF COST OF SALES FOR JANUARY 19

FORM 142. COST OF SALES JOURNAL VOUCHER

mental accounts as shown by Form 143. Figures required for the analysis of the selling price are obtained from the cost estimate sheet, Form 127. Each item in the column headed "Sales" is posted to

SALES DISTRIBUTION JOURNAL VOUCHER

Date No.

Department	Sundries Dr.	✓	Accounts Receivable Dr.	✓	Sales Cr.
Stock					60,500
Cutting					8,400
Ruling					6,250
Composition					2,520
Job Press 10 X 15					12,090
Job Press 14 X 22					11,830
Cylinder Press A					5,640
Cylinder Press B					5,280
Bindery					5,900
Outside					4,650
Selling					36,920
Total			159,760		

Distribution of Sales for January 19

FORM 143. SALES DISTRIBUTION JOURNAL VOUCHER

LOSS AND GAIN JOURNAL VOUCHER

Date No.

Account		✓	Charge	✓	Credit
Stock			650		
Cutting			120		
Ruling			960		
Composition			20		
Job Press			750		
Cylinder Press					820
Bindery			600		
Outside			50		
Selling			6,910		
Loss and Gain					9,240

Approved

FORM 144. LOSS AND GAIN JOURNAL VOUCHER

the proper Departmental Loss and Gain account. Thus, the difference between each department's cost of sales and sales, as shown by the Cost of Sales Journal Voucher (Form 142) and the Sales Dis-

tribution Journal Voucher (Form 143), gives the profit or loss for the department for the period. The method of operating the Departmental Loss and Gain accounts will be explained in connection with the Ledger entries in a subsequent section.

564. Loss and Gain Journal Voucher.— The closing entry for the accounting period is shown in Form 144. The net credit to loss and gain is seen to be $9,240. Losses and gains are separated by departments in order to render the preparation of financial statements an easy matter. The individual items in the charge and credit columns are posted to the Departmental Loss and Gain accounts, as will be shown later, the net result of manufacturing and trading operations for the period being then carried to the Loss and Gain account.

565. Pro Forma Ledger Accounts.— The cost accounts required by a job printer are Raw Material, Manufacturing, Production, Supplies, Payroll, Expense Burden, and Selling Expense. Of these the first four are inventory accounts and show the investment in material, work in process, finished goods, and supplies. They are, therefore, opened with an inventory. The Payroll and Expense accounts clear at the end of each accounting period and so do not show balances. Reference to the *pro forma* Ledger accounts given at the end of this section shows how the cost accounts appear at the end of an accounting period after the various journal vouchers (Forms 137 to 144) have been posted. The cost accounts show that the Manufacturing account is charged for the initial inventory, raw material drawn out of stores on requisitions, productive labor reported on employees' time tickets, and factory burden like any other job-order industry. All jobs finished are credited to Manufacturing at the costs shown on the Individual-Order Cost Sheet (Form 25). The Production account is charged for the initial inventory of finished goods and for the cost of goods manufactured as shown by the cost sheets. When the finished product is sold, the Production account is credited and the Cost of Sales account charged at the cost shown on the cost sheets. The cost of sales has to be kept separate by departments and, therefore, the Departmental Loss and Gain accounts will next be explained.

Separate Departmental Loss and Gain accounts are opened for the purpose of showing which departments are run at a loss and which are run at a profit. There are nine of these accounts, each of which is charged for the cost of work done in them, as shown by the Indi-

vidual-Order Cost Sheets (Form 25) for the jobs shipped. The accounts are also credited for the sales of this product, as shown by the Estimate Sheets (Form 127). It will then be seen that the difference between the cost of work done in any one department and the sales of the services or product of that department for the period in question shows the profit or loss on the department. These departmental accounts are all closed into the Loss and Gain account as shown. The departmental accounts show that the result of the operations for the period was a gain on all of the departments except the cylinder-press department, which was operated at a loss. *Pro forma* Ledger accounts as they would appear on the books of a job printer follow.

COST ACCOUNTS

Raw Material

Dr.			Cr.		
1	Inventory	$22,020.00	31	Manufacturing	$36,320.00
31	Purchases	40,000.00		Cost of Sales	700.00
			31	Balance, Inventory	25,000.00
		$62,020.00			$62,020.00
1	Balance brought down	$25,000.00			

Manufacturing (Work in Process)

Dr.			Cr.		
1	Inventory	$ 38,989.50	31	Production	$120,720.00
31	Raw Material	36,320.00		Burden	500.00
	Pay Roll	26,490.50	31	Balance, Inventory	20,000.00
	Burden	39,420.00			
		$141,220.00			$141,220.00
1	Balance brought down	$ 20,000.00			

Production (Finished Goods)

Dr.			Cr.		
1	Inventory	$ 6,780.00	31	Cost of Sales	$120,000.00
31	Manufacturing	120,720.00		Balance	7,500.00
		$127,500.00			$127,500.00
1	Balance brought down	$ 7,500.00			

Supplies

Dr.			Cr.		
1	Inventory	$ 320.00	31	Burden	$ 500.00
31	Purchases	2,700.00	31	Cost of Sales	20.00
			31	Balance	2,500.00
		$ 3,020.00			$ 3,020.00
1	Balance brought down	$ 2,500.00			

Payroll

Dr.				Cr.		
				31	Manufacturing	$26,490.50
7	Cash	1	$14,000.00	31	Selling Expense	33,509.50
14	Cash	2	15,000.00			
21	Cash	3	16,000.00			
28	Cash	4	15,000.00			
			$60,000.00			$60,000.00

Expense Burden

Dr.			Cr.		
31	Supplies	$ 500.00	31	Manufacturing	$39,420.00
31	Pay Roll	33,509.50	31	Selling Expense	30,010.00
31	Sundries	18,500.00			
31	Manufacturing	500.00			
31	Purchases	16,420.50			
		$69,430.00			$69,430.00

Selling Expense

Dr.			Cr.		
31	Burden	$30,010.00	31	Cost of Selling	$30,010.00

DEPARTMENTAL LOSS AND GAIN ACCOUNTS

Stock

Dr.			Cr.		
31	Cost of Sales	$59,850.00	31	Sales	$60,500.00
31	Loss and Gain	650.00			
		$60,500.00			$60,500.00

Cutting

Dr.			Cr.		
31	Cost of Sales	$ 8,280.00	31	Sales	$ 8,400.00
31	Loss and Gain	120.00			
		$ 8,400.00			$ 8,400.00

Ruling

Dr.			Cr.		
31	Cost of Sales	$ 5,280.00	31	Sales	$ 6,240.00
31	Loss and Gain	960.00			
		$ 6,240.00			$ 6,240.00

Composition

Dr.			Cr.		
31	Cost of Sales	$ 2,500.00	31	Sales	$ 2,520.00
31	Loss and Gain	20.00			
		$ 2,520.00			$ 2,520.00

Job Presswork

Dr.			Cr.		
31	Cost of Sales	$11,690.00	31	Sales	$12,090.00
31	Cost of Sales	11,480.00	31	Sales	11,830.00
31	Loss and Gain	750.00			
		$23,920.00			$23,920.00

Cylinder Presswork

Dr.			Cr.		
31	Cost of Sales	$ 6,060.00	31	Sales	$ 5,640.00
31	Cost of Sales	5,680.00	31	Sales	5,280.00
			31	Loss and Gain	820.00
		$11,740.00			$11,740.00

Outside Work

Dr.			Cr.		
31	Cost of Sales	$ 4,600.00	31	Sales	$ 4,650.00
31	Loss and Gain	56.00			
		$ 4,650.00			$ 4,650.00

Binding

Dr.			Cr.		
31	Cost of Sales	$ 5,300.00	31	Sales	$ 5,900.00
31	Loss and Gain	600.00			
		$ 5,900.00			$ 5,900.00

Selling

Dr.			Cr.		
31	Selling Expense	$30,010.00	31	Sales	$36,920.00
31	Loss and Gain	6,910.00			
		$36,920.00			$36,920.00

Loss and Gain

Dr.			Cr.		
			31	Sundries	$9,240.00

566. Loss and Gain Account.— All departmental accounts are closed into the Loss and Gain account. An analysis of the Loss and Gain account is shown in Form 145 set up in such a way as to obtain a forecast of conditions. In the accompanying statement (Form 145) the forecast for the cylinder-press department is a "Loss" and for all the other departments a "Gain." With this information available steps can be taken readily to prevent a recurrence of the loss. The net result of operations is shown to be a gain of $9,240.

145

THE AKRON PRINTERY
LOSS AND GAIN
JANUARY 19

Department	Loss	Department	Gain
Stock		Stock	650
Cutting		Cutting	120
Ruling		Ruling	960
Composition		Composition	20
Job Press		Job Press	750
Cylinder Press	820	Cylinder Press	
Bindery		Bindery	600
Outside		Outside	50
Selling		Selling	6,910
Gain in January	9,240		
Total	10,060	Total	10,060

Form 145. Loss and Gain Account

567. Balance Sheet.— A "Balance Sheet" containing all the assets and liabilities of the printery is given in Form 146. It will be noticed that the item "Reserve for Bad Debts" is deducted from "Accounts Receivable" and the item "Reserve for Depreciation" from "Plant." The gain of $9,240, as shown in the Balance Sheet, agrees with the amount shown in the Loss and Gain account, Form 145.

The foregoing description of the form and accounts used by a job printer are suggestive of the procedure to be followed in any job-order factory when the method of cost finding is based on making a charge per productive or "sold-hour" for the services rendered by the various departments to the different jobs produced. The method is applicable to paper box, lithographing, and nearly all other industries where estimates have to be made on new work.

568. Newspaper Costs.— When a job-printing establishment is operated in connection with a newspaper, it is the best practice to have the job department take the newspaper as a job and bill it, at cost, to the newspaper. By this means the expense of composition, proofreading, and presswork can be charged on the proper basis to the newspaper. Departments such as editorial, circulation, stereotyping, and advertising do not have anything to do with the jobbing end of the business, and so their expense is all chargeable directly to the newspaper.

146

THE AKRON PRINTERY
BALANCE SHEET
AS AT THE CLOSE OF BUSINESS JANUARY 31, 19

ASSETS			LIABILITIES		
CURRENT ASSETS			CURRENT LIABILITIES		
CASH		2,250	ACCOUNTS PAYABLE		16,000
ACCOUNTS RECEIVABLE	27,000		NOTES PAYABLE		5,000
LESS RESERVE FOR BAD DEBTS	1,250	25,750			
INVENTORY			TAXES ACCRUED		25
RAW MATERIAL		25,000			
MANUFACTURING		20,000			
PRODUCTION		7,500			
SUPPLIES		2,500	CAPITAL		75,000
PLANT					
FURNITURE	7,050		SURPLUS		
MACHINERY	25,000		SURPLUS	23,135	
LAND AND BUILDINGS	32,050		LOSS AND GAIN	9,240	32,375
	65,100				
LESS RESERVE FOR DEP'N.	20,000	45,100			
INSURANCE PREPAID		300			
TOTAL ASSETS		128,400	TOTAL LIABILITIES		128,400

FORM 146. BALANCE SHEET

569. Sales Analysis.— The form of sales analysis best adapted for a printing concern seems to be one showing the profit on operations by departments, as explained in foregoing sections of this chapter. The same scheme for the departmentalization of profits and losses can be used in establishments where the cost of the work done in each department can be set up against the sales of the services of departments.

570. Commodity Classifications.— In many lines of business it is the practice to analyze sales according to the various classes of goods sold, rather than by factory departments. Thus, in a jewelry manufacturing enterprise the sales classifications might be brooches, buckles, hat pins, rings, fobs, chains, and so on. If this is the case, the sales and cost of sales of each class of goods should be set up and

the operating profit on each class shown. Under such conditions it is evident that the commodity classification governs. This, it may be said, is the most common, as well as the simplest method.

571. Summary.— Whether to analyze sales according to factory departments or commodity classifications depends upon the information wanted. In the mechanical industries the analysis of sales is usually by classes of goods, but job printers favor making the cost analysis according to manufacturing departments. The same is true throughout the novelty line. The cost system of a job-order factory makes possible any kind of analysis desired so that the proprietor of an enterprise may be informed regarding the profitable as well as the unprofitable lines. The cost system also provides the means necessary for the setting up of the monthly balance sheet because the book inventories show the stock on hand, necessitating no adjustment. The complete interlocking of the costs and financial accounts represents the highest development of accounting.

QUESTIONS ON CHAPTER XLI

1. What kind of a cost system is best adapted to meet the needs of a job printer?
2. What is the plan of cost finding recommended by the American Printers' Cost Commission?
3. What function is served by a printer's estimate sheet?
4. What sort of a production order does a printer use?
5. How are the following forms used: stores requisition, compositor's daily time ticket, pressroom daily time ticket, bindery daily time ticket, payroll, monthly record of productive and non-productive hours, monthly record of productive and non-productive hours and press impressions?
6. How is the analysis of hourly service costs made?
7. How are job-order costs compiled?
8. What Journal entries are required at the end of each month to close the cost accounts?
9. By means of *pro forma* Ledger accounts show how the cost accounts would appear on the books of a printer.
10. In case a job-printing establishment is run in connection with a newspaper, how should the cost of the latter's composition and presswork be handled?

CHAPTER XLII

ESTIMATING COST SYSTEM OR PREDETERMINED JOB COSTS

572. **Standard Costs.**— In some lines of manufacture it is impracticable to make an exact calculation of the cost of each unit of the product after operations have been completed because of the volume of clerical work involved. When this is the case it is necessary to fall back on cost estimates which are often prepared for each new style of goods put into the sample line. Under the conditions of operation found in certain industries these so-called standard or predetermined cost figures furnish the management with a fairly satisfactory basis on which to establish selling prices. However, it is never safe to rely solely upon estimates and so a method for controlling such costs needs to be put into operation. The method of using and controlling cost estimates will be explained in this chapter.

573. **Costs in Garment and Shoe Factories.**— The needle and leather-goods industries are adapted, for the most part to predetermined costs. In making cloaks and suits, members of the cutting-up trade estimate the cost of each style in advance of the time when manufacturing operations are commenced. Shoe manufacturers also follow the same practice and calculate what the cost of an average size pair of shoes in each style will be. The material used for garments and shoes is cut according to special patterns and so the quantity estimated to be used for a unit of the product is expected to be the same as that actually cut up. However, the price of material must be estimated unless the stock required has been already purchased. If operatives are paid at piecework rates, the labor cost can be calculated easily. If the hour-work wage system prevails, it is necessary to estimate the labor cost for the various operations on the basis of past experience. Overhead is then added to the prime cost as a burden in the usual way. Thus one sees that the general cost formula is applied to figuring *predetermined costs* in a way similar to that in any job-order cost system.

574. **Loss and Gain on Estimates.**— After cost estimates have been made for the product the next step is to put into operation the checking system to see whether they are on an average too high or too low. The method of procedure is to provide a means for comparing *actual* costs with the *estimated* costs of material, labor, and overhead. This comparison is not made by jobs but in lump sums; the material consumed is compared with estimated requirements for the production of the period; the direct labor payroll with the total estimated labor cost; and the actual overhead with the estimated burden. Differences between the actual and estimated costs are carried to an adjustment account called Loss and Gain on Estimates. There can be as many of these adjustment accounts as are deemed necessary. It is likely that it will be found advisable to have at least one such account for each main element of cost.

575. **A Hypothetical Case.**— The reason for bestowing special care on the adjustments of material, labor, and overhead in an estimating cost system is because predetermined costs are the only ones available, and so the differences between actual consumption and estimated requirements cannot be charged to the cost accounts but must be charged to a Loss and Gain on Estimates account. Forms used in a factory where a system of predetermined costs is in operation must be ruled to show the difference between the exact value of stock used and the estimated cost. The procedure is illustrated by the following tabulation, based on the practice in shoe factories:

REQUISITION FOR UPPER LEATHER

Item	Estimated Cost	Actual Cost	Loss	Gain
Case 1.....	$20.00	$23.00	$3.00	
" 2.....	10.00	9.00		$1.00
" 3.....	20.00	23.00	3.00	
	$50.00	$55.00	$6.00 Net Loss, $5.00	$1.00

From the above tabulation it is seen that the estimated cost of upper leather in Cases 1, 2, and 3 is $50, as against the actual cost of $55, thereby resulting in a loss of $5. It is, therefore, apparent that if the cost of upper stock is estimated at $50, and no other cost than the predetermined one for a particular style is available, the Work in

Process account can only be charged for $50. If the Work in Process account were to be charged with the actual cost of $55, it would mean that the original estimate would have to be changed, a procedure which is impractical in factories relying upon a system of predetermined costs. After production has been completed shoes are taken out of process on the basis of estimated costs, and charges corresponding to the estimates are made to the Work in Process account. The difference of $5 in the hypothetical case above cited is, therefore, charged to the Loss and Gain on Upper-Stock Estimates account. This account at the end of a period is closed out to profit and loss.

576. **Factory Profit and Loss.**— The merchandising end of the business buys the stock from the manufacturing division at the estimated cost, and if the factory produces its product at less than the estimate, a factory profit results. However, if the product costs more than estimated, a factory loss is sustained. The loss or gain on estimates, due to the factory operations, must be added to the profit or loss on trading and selling in order to learn the net result on the business for the period.

577. **Cost of Sales.**— In an estimating cost system the merchandise produced is priced at the predetermined cost, because this is the only cost available. By this means the cost of merchandise produced is taken out of the Work in Process account and charged to the Finished Goods account. Merchandise when sold is priced in accordance with the predetermined cost figures and an entry made crediting the finished goods and charging the Cost of Sales account. The balance to the Raw Material account represents the inventory of stock on hand at actual cost. The balance to the Work in Process account represents the partly completed product at the estimated cost, based on the state of completion in which the product is found at the date of inventory. The balance to the Finished Goods account represents the value of the completed product on hand at estimated prices.

578. **Standardized Material Costs.**— The principles underlying the estimating cost system are capable of wide application. Thus, in a very large motor-truck building company the plan of cost finding, in so far as material is concerned, is based on billing the factory with all purchases at the estimated prices, the difference between these and the actual prices being charged to an adjustment account. By this

means the factory is enabled to use standard prices in figuring costs. The material used is mostly metal and the quantity is standardized by the engineering department. Thus, with the *price* and the quantity standardized the *cost* of material in a unit of the product is not subject to variation. This simplifies matters because the cost of material in the same article is not subject to continual change due to price fluctuations. The Adjustment account keeps the managers posted as to the aggregate of price variations so that they can determine whether or not selling prices should be revised.

579. **Shoe Factory Accounts.**— In order to explain the operation of the General Ledger accounts in a plant in which the estimating system applies, reference will be made to the accounts in a typical shoe factory. In the making of a shoe there are more single steps than in the making of any article sold for so low a price. Furthermore, most of the important elements of cost are established in advance. A large part of the machinery used is leased on a royalty basis. Labor processes are fairly well standardized and frequently piecework prevails. Only the cost of leather is variable to any great extent. Factory overhead is relatively small compared with the other elements of cost and can be readily disposed of as a burden on direct labor. The cost system in a shoe factory begins with making out the "Cost Estimate Sheet" (Form 24).

580. **Cost Sheet.**— In the estimating system used by shoe manufacturers the cost sheet contains all the information regarding any style. The method of making the calculation of the "standard cost" was explained in section 90. Reference is made to the cost sheet when figuring inventories and costing sales, as previously explained. In order to understand the application of the cost sheet to the operating conditions in shoe factories, a few words of explanation about manufacturing processes are necessary.

581. **Shoes Classified.**— There are three classes of shoes made, known as the Goodyear-welt, the McKay-sewed, and turned. All high-grade shoes worn by men belong to the first class. In the Goodyear process the welt, a narrow strip of leather, is sewed to the upper and insole, after which the outsole is sewed to the welt. Shoes made by the Goodyear-welt process are easily identified because the heavy stitches which unite the sole to the welt show outside of the upper. In the McKay process the sole is sewed to the upper and insole by

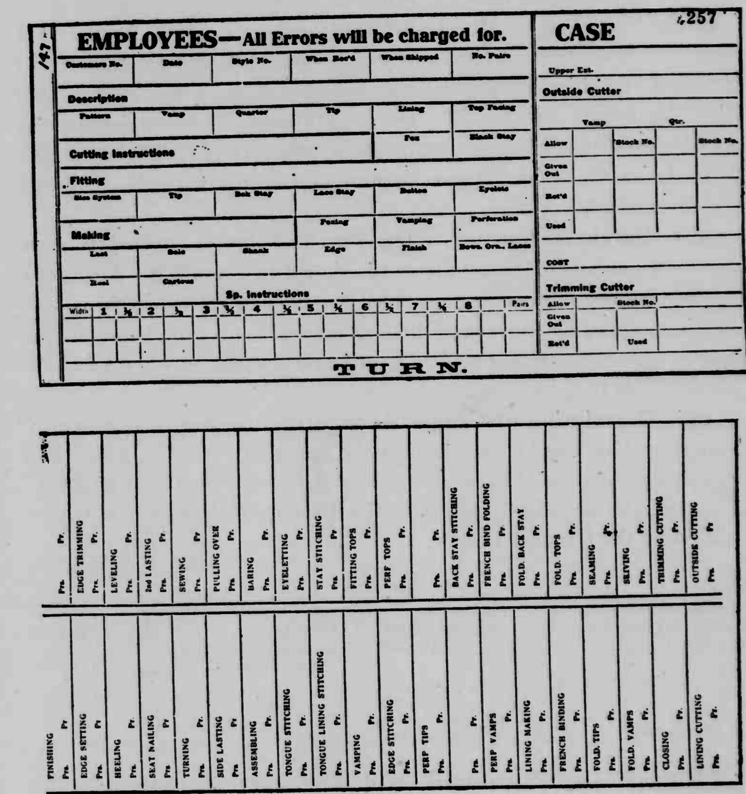
means of stitches made inside of the shoe instead of outside, as in the first method described. Shoes made by the third method are sewed together and then turned inside out by means of special machinery. Only light-weight women's shoes and slippers can be made by this method. The various manufacturing processes are quite well standardized and are about the same in one shoe factory as another.

582. **Shoe-Factory Processes.**— The first step in making shoes is to cut out the pieces of material required for the upper and sole-leather parts. The work of cutting upper leather and linings is facilitated by the use of special patterns. Outsoles and insoles are usually cut out by means of delicate dies which are pressed through the sole leather by powerful machines designed for the purpose. The pieces for the upper portion of the shoes are sewed together and eyeleted, and the next step is to draw the upper over a wooden last which gives the shoe its proper shape. The sole leather parts are next fastened to the upper and the heels attached. Lastly, the shoes have to be finished and packed in cartons ready for shipment. Thus, one sees that shoes pass through many processes, generally referred to as cutting, stitching, lasting, making, heeling, finishing, and packing.

583. **Shoe Tag.**— Generally orders for shoes are received from salesmen long in advance of the time when shipment is to be made. From the information contained on the salesmen's orders, "Shoe Tags," such as shown in Form 147, are made out. The Shoe Tag illustrated is of the coupon form so that operatives can tear off coupons corresponding to the operations which they perform. The coupons, marked with the operatives' clock numbers, are sent to the office so that the payroll earnings of pieceworkers can be computed. The body of the Shoe Tag is made in quadruplicate so that copies can be sent to the cutting, making, and finishing departments, while the original remains in the office. The tag with coupons follows the lot through the factory. Generally a separate Shoe Tag is made out for each case.

584. **Day-Sheet System.**— After shoe tags have been typewritten they are usually placed in a tray, from which the superintendent selects tags for each day's work. Every shoe factory has a certain capacity, of say 30 to 100 cases daily. If this condition prevails, it is necessary for the superintendent to put the required number of shoe tags in work each day. Shoe tags selected for the day's work are

entered on a sheet called a "Day Sheet," from whence the procedure gets the name of the day-sheet system. As many copies of the day sheet as necessary are prepared to provide each department in the factory with a copy, and a distinguishing color is used for each copy



FORM 147. SHOE TAG

of the sheet. The superintendent enters on the top of each sheet the date when operations should be completed in the respective departments. Thus, if a day sheet containing the numbers of 30 shoe tags is issued on the first of a month, the cutting operation on the shoes should be completed on the 3rd, lasting on the 5th, making on

the 7th, and so on. Each day the foremen go about their departments and check off that day's work on their copy of the day sheet. At the close of the day the sheet is sent to the office to show that the work scheduled has been completed. If work on an order cannot be completed, an explanation of the cause of delay is entered on the sheet and the Shoe Tag number transferred to the day sheet for the next day. Shoes which go into work on any one day are scheduled to be finished and shipped on a definite date and it is, of course, desirable that the date be adhered to. Day sheets notify the cost department of what work has been done and also the quantity of each style to take out of the Work in Process account and transfer to the Finished Goods account.

585. Purchase Journal.— The Purchase Journal suited to meet the requirements of a shoe factory is shown in Form 35. A number of distribution columns are provided for the classification of vendors' invoices according to General Ledger accounts. At the close of each month the Purchase Journal is footed and postings made directly to the accounts in the Ledger.

586. Description of Ledger Accounts.— Inasmuch as it is very important that the Ledger accounts be operated correctly, a detailed description of each of those affected by the cost system will be given. The accounts described appear in the Factory Ledger, which is controlled by the General Ledger.

Dr. SUPPLIES *Cr.*

1	Inventory	$100.00	31	Inventory	$ 50.00
31	Purchases	100.00	31	Balance, charged to Factory Expense account	150.00
		$200.00			$200.00
1	Inventory	$ 50.00			

All supplies which are used about the factory are charged to the Supplies account. The account is closed by estimating the inventory value of any supplies remaining on hand and charging the balance to the Factory Expense account.

The upper stock consists of calf skins, kid skins, cloth, and silk used for the upper portion of the shoe. It is all charged to the Upper Stock account in the Factory Ledger. The coupon from the copy of the production order given to the foreman of the cutting

Dr. UPPER STOCK *Cr.*

1	Inventory	$20,000.00	31	Actual stock used for making uppers as reported on the coupon of the production order, charged to Loss & Gain on Upper Leather Estimates account	$10,000.00
31	Purchases	6,000.00	31	Balance, Inventory of Upper Stock	16,000.00
		$26,000.00			$26,000.00
1	Balance, brought down	$16,000.00			

room, shows the estimated allowance of upper stock per 100 pairs of shoes and also the actual quantity consumed. These coupons are used for accounting purposes just as are ordinary requisitions on the stock room. The coupons are entered on the issued side of the Upper-Stock Ledger according to lot number, and the quantity of feet priced and extended. At the end of the month all coupons which have been turned in for the period are summarized to obtain the actual value of upper stock used. An entry is then made crediting the Upper-Stock account for this amount, and charging an account called Loss and Gain on Upper Leather Estimates. The balance to the Upper Stock account represents the inventory value of the upper stock on hand at the close of the accounting period and is set up on the Balance Sheet.

Dr. LOSS AND GAIN ON UPPER LEATHER ESTIMATES *Cr.*

31	Actual stock used for making uppers as reported on the coupon of the production order, credited to Upper Stock account	$10,000.00	31	Estimated stock required for making uppers as reported on the coupon of the production order, charged to Work in Process account	$ 9,500.00
			31	Profit & Loss	500.00
		$10,000.00			$10,000.00
	[A debit balance represents a loss on upper leather estimates.]			[A credit balance represents a gain on upper leather estimates.]	

Actual stock used for making uppers for the shoes is charged to the Loss and Gain on Upper-Leather Estimates account. The reason is that under the conditions imposed by the operation of a system where job costs are estimated in advance of manufacturing operations, it is not practicable to charge the actual upper stock directly into the

Work in Process account. Inasmuch as the only cost that is available is the estimated cost, it is necessary to credit the Work in Process account not only for the estimated cost of manufacture but also to charge the account for the estimated cost of the various elements which make up the shoes produced.

The estimated stock required for uppers, as reported on the cutters' coupons of the production orders, is credited to the Loss and Gain on Upper-Leather Estimates account and charged to the Work in Process account. It is thus seen that if the actual upper stock used is more than the estimated requirement, a loss will result; but if the actual consumption is less than the estimated allowance, a gain will result. The balance of the Loss and Gain on Upper-Leather Estimates account is closed out to the Profit and Loss account.

Dr. BOTTOM PARTS *Cr.*

1	Inventory	$5,000.00	31	Stock used for bottom parts as shown by the stock fitters' coupons to the production order and estimated amount of heels used, charged to Work in Process account	$6,000.00
31	Purchases	4,000.00	31	Balance, inventory	3,000.00
		$9,000.00			$9,000.00
1	Balance, brought down	$3,000.00			

The bottom parts used in manufacturing shoes consist of outer soles, shanks, heels, and counters, and when purchased are charged to the Bottom Parts account. All the bottom parts, except the heels, are prepared in the sole-leather stockroom or stock-fitting department, as it is called, ready for attaching to the upper parts. The copy of the production order which goes to the stock fitter has a coupon attached on which an entry is made of the number of bottom parts given out, and also of their grade. These coupons are used just as any stores requisitions. The bottom parts issued are entered on the credit side of the Bottom-Parts Stock Ledger. They are priced and extended to obtain the amount. At the end of each month the total value of bottom parts reported on the stock-fitters' production order coupons is obtained and an entry made charging the Work in Process account and crediting the Bottom-Parts account.

One of the final operations in making the shoe is that of attaching

the heel. The day sheet which is received from the finishing department shows how many pairs of shoes have been finished. The practice is to credit the Bottom-Parts account and charge the Work in Process account for the number of heels required for the shoes finished. An entry can be made on the Bottom-Parts Stock Ledger covering the quantity and value of heels used.

The balance of the Bottom-Parts account should agree with the sum of the balances appearing on the subsidiary Bottom-Parts Stock Ledger cards. The balance represents the inventory value of bottom parts and is set up on the Balance Sheet.

Dr. TRIMMINGS AND LININGS *Cr.*

1	Inventory	$1,500.00	31	Requisitions for pieces of trimming and lining stock	$1,500.00
31	Purchases	500.00	31	Balance, inventory of trimmings and linings	500.00
		$2,000.00			$2,000.00
1	Balance, brought down	$ 500.00			

All purchases of material for trimmings and linings of shoes are chargeable to the Trimmings and Linings account. Reports are to be made when piece goods are opened and a credit made on the subsidiary Stock Ledger employed to keep a record of this class of material. The same form of Ledger that is used for bottom parts can be employed. At the end of each accounting period, the controlling account should be reconciled with the subsidiary Ledger. The balance of the Trimmings and Linings account represents the inventory value of this material on hand, and is set up on the Balance Sheet.

Dr. FINDINGS *Cr.*

1	Inventory	$250.00	31	Estimated amount of findings used for making shoes, charged to Work in Process account	$500.00
31	Purchases	600.00	31	Balance, inventory of findings	350.00
		$850.00			$850.00
1	Balance, brought down	$350.00			

The buttons, eyelets, hooks, laces, box toes, and straps, when purchased, are charged to the Findings account. In making estimates

of the cost of manufacturing shoes, it is the practice to make a certain allowance to cover this class of miscellaneous material. At the end of the month, a credit to the account is made covering the estimated amount of findings used for the total production. No subsidiary Stock Ledger is kept for findings. The balance of the Findings account represents the inventory values of the findings remaining on hand and is shown on the Balance Sheet.

Dr. CARTONS *Cr.*

1	Inventory	$200.00	31	Estimated amount of cartons used in packing shoes, charged to Work in Process account	$150.00
31	Purchases	100.00	31	Balance, inventory of cartons	150.00
		$300.00			$300.00
1	Balance, brought down	$150.00			

When estimating the cost of shoes, a separate allowance is made to cover the cartons in which they are packed. The cartons purchased are charged to the Cartons account. At the end of the month this account is credited for the amount of cartons required to pack the shoes shipped. The balance of the account represents the inventory value of cartons and is set up on the Balance Sheet.

Dr. LASTS AND PATTERNS *Cr.*

1	Inventory	$5,000.00			
31	Purchases	1,000.00			
		$6,000.00			

Both patterns and lasts are comparatively short lived. It is, therefore, the practice to make a suitable allowance to cover the cost of patterns and lasts, when estimating the cost of producing shoes. All purchases of lasts and patterns are charged to the Lasts and Patterns account.

Dr. RESERVE FOR DEPRECIATION ON LASTS AND PATTERNS *Cr.*

			31	Estimated depreciation on lasts and patterns, charged to Work in Process account	$250.00

At the end of each accounting period, the estimated expense of providing lasts and patterns for the period is calculated by multiplying the number of shoes finished by the rate used to cover depreciation. An entry is made crediting the Reserve for Depreciation on Lasts and Patterns account and charging the Work in Process account.

On the Balance Sheet, the "Reserve for Depreciation of Patterns" is shown as a deduction from the Lasts and Patterns account.

Dr. WORK IN PROCESS *Cr.*

1	Inventory	$15,000.00	31	Finished Goods at estimated cost of manufacture, as per factory shipping record and bill to N. Y. Office, charged to General Ledger account	$30,000.00
31	Estimated stock required for making uppers as reported on the coupon of the production order, credited to Loss and Gain on Upper Leather Estimates account	9,500.00	31	Spoiled work charged to Factory Expense account	100.00
	Stock used for bottom parts as shown by the stock fitters' coupons to the Production Order, and estimated amount of heels used, credited to Bottom Parts account	6,000.00	31	Balance, inventory of work in process	10,000.00
	Trimming and lining material requisitions credited to Trimmings and Linings account	1,500.00			
	Estimated amount of findings used for making shoes, credited to Findings account	500.00			
	Lasts and patterns depreciation credited to Reserve for Depreciation on Lasts and Patterns account	250.00			
	Royalties accrued on leased machinery, credited to Royalties Accrued account	200.00			
	Estimated amount of cartons used in packing shoes, credited to Cartons account	150.00			
	Direct labor credited to Payroll account	5,000.00			
	Factory expense credited to Factory Expense account	2,000.00			
		$40,100.00			$40,100.00
1	Balance, brought down	$10,000.00			

All the elements that enter into the cost of the shoes produced are charged to the Work in Process account. The cost of a shoe consists of the cost of upper leather, bottom parts, trimming and lining material, findings, depreciation on lasts and patterns, royalties, cartons, direct labor, and factory expense. At the end of each accounting period, the cost of the finished product is credited to the Work in Process account and charged to the General Ledger account. If shoes are spoiled, the charge is made to the Factory Expense account. The estimated cost of manufacture is the figure used in pricing the production. The balance to the Work in Process account represents the inventory value of goods still in process of manufacture at the end of the accounting period. This balance is set up on the Balance Sheet.

Dr. MACHINERY AND EQUIPMENT *Cr.*

1	Inventory	$22,950.00			
31	Purchases	1,150.00			
		$24,100.00			

All machinery and equipment purchased is charged to the Machinery and Equipment account. When plant items are scrapped or sold, they are credited to this account and charged to the Reserve for Depreciation on Machinery and Equipment account. The balance to the Machinery and Equipment account represents the cost of machinery and equipment on hand.

Dr. RESERVE FOR DEPRECIATION ON MACHINERY AND EQUIPMENT *Cr.*

			31	Depreciation on machinery and equipment charged to Factory Expense account	$400.00

The estimated depreciation on machinery and equipment will be credited to the Reserve for Depreciation on Machinery and Equipment account monthly. On the Balance Sheet the Reserve for Depreciation on Machinery and Equipment appears as a deduction from the cost of plant.

Dr. INSURANCE UNEXPIRED *Cr.*

31	Purchases	$500.00	31	Amount of insurance premiums expired during the period, charged to Factory Expense account	$100.00
			31	Balance, inventory value of unexpired insurance premiums	400.00
		$500.00			$500.00
1	Balance, brought down	$400.00			

When insurance premiums are paid, they are charged to the Insurance Unexpired account. At the end of each month, the amount of insurance premiums which expired are written off, leaving a balance representing the cost of the unexpired portion of the policies. This balance is set up on the Balance Sheet.

Dr. ACCOUNTS PAYABLE *Cr.*

31	Amount of invoices settled, credited to General Ledger account	$10,000.00	31	Purchases:	
31	Balance, amount of unpaid invoices	4,750.00		Supplies	$ 100.00
				Upper Stock	6,000.00
				Bottom Parts	4,000.00
				Trimmings and Linings	500.00
				Findings	600.00
				Royalties	150.00
				Lasts and Patterns	1,000.00
				Cartons	100.00
				Factory Expense:	
				Express and Freight	50.00
				Light, Heat and Power	150.00
				Repairs	25.00
				Rent	400.00
				Sundry Purchases	25.00
				Insurance	500.00
				Machinery and Equipment	1,150.00
		$14,750.00			$14,750.00
			1	Balance, brought down	$ 4,750.00

The total of all purchases is credited to the Accounts Payable account. When invoices are settled, a charge is made to the Accounts Payable account. The balance of the account represents the balance due creditors, and appears as a liability on the Balance Sheet.

Dr. ROYALTIES ACCRUED *Cr.*

31	Purchases	$150.00	31	Amount of machine royalties accrued on shoes produced, charged to Work in Process account	$200.00
31	Balance, amount of machine royalties due but not paid	50.00			
		$200.00			$200.00
			1	Balance, brought down	$ 50.00

A large part of the machinery is leased from the owner on a royalty basis. The royalties accrued on leased machinery are credited to Royalties Accrued account. Payments to the owner on account of royalties are charged to this account. The balance is brought down as a liability and is shown as such on the Balance Sheet.

Dr. FACTORY EXPENSE *Cr.*

31	Indirect Labor	$ 500.00	31	Amount of factory expense applied as a burden on shoes, charged to Work in Process account	$2,000.00
	Supplies	150.00			
	Express and Freight	50.00			
	Light, Heat and Power	150.00			
	Repairs	25.00			
	Rent	400.00			
	Sundry Purchases	25.00			
	Spoiled Work	100.00			
	Depreciation on Factory Equipment	400.00			
	Insurance	100.00			
	Profit and Loss	100.00			
		$2,000.00			$2,000.00
	[A debit balance represents an excess of factory expense over the estimated burden.]			[A credit balance represents a decrease of factory expense under the estimated burden.]	

All items of expenditure not entering directly into the prime cost of a shoe, are charged to the Factory Expense account. At the end of the month, the Factory Expense account is credited for the amount of burden applied on the product. The amount is determined by multiplying the number of pairs of shoes finished by the factory-expense rate used per pair in the calculations. Thus, if the rate is $2 per pair and the production is 1,000 pairs, the credit is $2,000.

The charge corresponding to the credit is made to the Work in Process account.

It is, of course, quite likely that the credit made to the Factory

Expense account will not exactly offset the charges for the month. A debit balance represents an excess of factory expense over the estimated burden, while a credit balance represents a decrease of factory expense under the estimated burden. If a balance remains, it is closed out to the General Ledger account.

Dr. PAYROLL *Cr.*

7	General Ledger	$1,500.00	31	Indirect labor charged to Factory Expense account	$ 500.00
14	General Ledger	1,500.00	31	Direct labor charged to Work in Process account	5,000.00
21	General Ledger	1,500.00			
28	General Ledger	1,000.00			
		$5,500.00			$5,500.00

The payroll checks are charged to the Payroll account. At the end of each period, the payrolls are analyzed and an entry made charging the indirect labor to the Factory Expense account and the direct labor to the Work in Process account, the Payroll account being credited.

It is frequently advisable that the books be closed in five- and four-week periods in order to save the labor of splitting the payroll when the end of the month does not coincide with the end of a payroll period.

Dr. PROFIT AND LOSS *Cr.*

31	Loss on upper leather estimate, credited to Loss and Gain on Upper Leather Estimates Account	$500.00	31	Adjustment to Factory Expense account, because the actual factory expense is less than the estimated burden	$100.00
			31	Balance	400.00
		$500.00			$500.00
1	Balance, brought down	$400.00			

The adjustments due to loss and gain on upper leather and factory expenses are closed out to the Profit and Loss account. It is not expected that the factory will show a profit on sales, because the profit is taken care of in the General Ledger account.

It is oftentimes the plan to operate the Factory Ledger separately from the General Ledger. In order to do this, it is necessary to open

GENERAL LEDGER

Dr.			Cr.		
31	Finished goods at estimated cost of manufacture, as per shipping record and bill to N. Y. Office, credited to Work in Process account	$30,000.00	1	Inventory:	
				Supplies	$ 100.00
				Upper Stock	20,000.00
				Bottom Parts	5,000.00
				Trimmings and Linings	1,500.00
				Findings	250.00
				Cartons	200.00
				Work in Process	15,000.00
				Lasts and Patterns	5,000.00
				Machinery and Equipment	22,950.00
31	Balance	55,500.00	7	Payroll	1,500.00
			14	Payroll	1,500.00
			21	Payroll	1,500.00
			28	Payroll	1,000.00
			31	Amount of invoices settled as per Cash Book and Journal, charged to Accounts Payable account	10,000.00
		$85,500.00			$85,500.00
			1	Balance, brought down	$55,500.00

a General Ledger account. The original inventory, payrolls, and cash disbursements made to liquidate factory invoices are credited to the General Ledger account. When finished goods are sold they are charged to the General Ledger account and credited to Work in Pro-

TRIAL BALANCE OF FACTORY LEDGER, JANUARY 31, 19—

Supplies	$ 50.00	
Upper Stock	16,000.00	
Bottom Parts	3,000.00	
Trimmings and Linings	500.00	
Findings	350.00	
Cartons	150.00	
Lasts and Patterns	6,000.00	
Work in Process	10,000.00	
Machinery and Equipment	24,100.00	
Insurance Unexpired	400.00	
Accounts Payable		$ 4,750.00
Royalties Accrued		50.00
Reserve for Depreciation on Lasts and Patterns		250.00
Reserve for Depreciation on Machinery and Equipment		400.00
General Ledger		55,500.00
Profit and Loss	400.00	
	$60,950.00	$60,950.00

cess. The balance of the General Ledger account appears on the credit side because the factory inventory accounts all have debit balances.

587. Trial Balance of Factory Ledger.— A trial balance taken from the Factory Ledger is herewith submitted in order to show just what accounts appear in it. When it is desired to make up a complete financial statement, the trial balance of the Factory Ledger is combined with that of the General Ledger.

588. Summary.— Operating conditions in many factories are such that it is impractical to go to the expense of trying to ascertain the amount of material, labor, and overhead expended upon each unit of the product. However, where such is the case, it often happens that at least one and sometimes all of the elements of cost can be estimated with a considerable degree of accuracy in advance of the time manufacturing operations begin. Of course, if an element of cost cannot be estimated with a close approximation to what the actual cost may be supposed to be, it is necessary to put into operation a system which will give the actual cost. The introduction of standard or predetermined costs requires that a means for exercising proper control over them be established in order that the managers may be advised as to any discrepancies between actual consumption and estimated requirements. The usual plan of procedure is to open one or more adjustment accounts called Loss and Gain on Estimates for the purpose of taking care of the variations between actual and estimated costs. These accounts are closed out to profit and loss.

QUESTIONS ON CHAPTER XLII

1. What sort of a cost system is adapted to garment and shoe factories?
2. How is a Loss and Gain on Estimates account operated? Illustrate.
3. In what way may material costs be standardized?
4. What function does the Shoe Tag perform in a shoe factory?
5. What is meant by the day-sheet system?
6. Name the cost accounts operated on the Ledger of a shoe factory.
7. What items are charged to the Work in Process account in a shoe factory?
8. How are shoe factory costs proved?

CHAPTER XLIII

TEXTILE COSTS

589. Textile Fibers.— The textile industry furnishes a broad field for the cost accountant. In a textile mill it is necessary that one have a general understanding of the industry involved in weaving various fibers into woven and knit fabrics. The raw material used in making textile fabrics is usually divided into three classes, known as the long vegetable fibers of commerce such as linen, hemp, jute; short fibers, comprising wool and cotton; and lastly, silk. The fibers in the first two classes possess the peculiar property of clinging together when in contact with each other, due to their serrated edges. The first process in the manufacture of textile products made from long vegetable fibers, cotton, or wool, is that of twisting the fibers together to form a single strand. Raw silk when purchased comes in the form of a delicate thread, and several single yarns must be twisted together to form ply yarns of sufficient strength for the making of thread to be woven or knitted into fabrics.

590. Ply Yarns.— When it is desired to make a rope, three three-ply sisal or hemp strands are twisted together in a reverse direction from which the original strands were twisted. Ropes are said to be cabled, or hawser-laid. The same process is followed in making cotton or linen sewing thread which usually consists of three three-ply strands.

591. Woven and Knit Fabrics.— Woven fabrics are made by interlacing filling yarns with warp yarns. The former run crosswise and the latter lengthwise of the fabric. Weaving is performed on a power loom which performs three operations in each cycle, known as shedding, picking, and beating up. In the first operation a part of the warp threads are raised and a part depressed so as to form a shed through which the shuttles carrying the filling yarn can pass. The warp threads are actuated by means of loom harnesses through the eyes of which the warp runs. The second operation in running a

loom consists in driving the shuttle containing the filling yarn across the loom; each passage of the shuttle from one side to the other weaves in one pick or thread of filling. The last operation is that of beating the pick up into place so as to make a compact fabric. Then the rear loom beam containing the warp unrolls and the forward loom beam containing the woven fabric rolls up. Knitted fabrics are made by continuously looping yarn together to form a fabric.

592. Finishing Fabrics.— After fabrics have been woven or knitted, it is usually necessary to finish them. In some cases gray cotton fabrics are bleached, dyed, and printed. Woolen fabrics are shrunk and pressed. Sometimes the finishing of textile fabrics is conducted as a separate branch of the industry. Those who buy goods in the gray and have them finished are known in the trade as "converters."

593. Process and Job Systems of Production.— The making of yarn, whether single or ply, is always treated as a process for most purposes. A single kind of raw material, such as cotton, passes through a certain series of operations in being made into single yarn. Special operations make single yarn into ply yarns. Finally yarn may be wound into skeins, put on spools, and so on. The knitting of fabrics is also a continuous process. However, the weaving of fabrics to conform to special designs is a job-order business. The superintendent of weaving always issues orders to prepare the warps and weave designs. The finishing of fabrics is usually carried on as a process or a series of processes, with the exception of printing, which is a job-order undertaking.

594. Yarn Numbering System.— Each kind of textile yarn is numbered in accordance with a certain system. The system followed in numbering yarn consists in letting the "count" equal the quantity of fixed lengths in a pound. If there is one of these fixed lengths in a pound of any kind of single yarn the number of the yarn is said to be *ONE*. In case there are 20 of these fixed lengths in a pound the yarn number is *TWENTY*. The fixed length is usually spoken of as a "hank." A hank of single cotton yarn has 840 yards; one of worsted yarn, 560 yards; one of woolen yarn, 1,600 yards; and one of linen yarn, 300 yards. One pound of No. 20 cotton yarn contains 20 times 840 yards, or 16,800 yards. A ply yarn is indicated by writing the ply number over the single-yarn number. Thus 2/20

stands for a two-ply yarn made from a single 20 yarn. It is equivalent to a single 10.

595. Organization of Fabrics.— The usual method of describing a woven fabric is to give the total number and kinds of ends of warp yarn and the number and kinds of picks per inch of yarn in the filling, and also the weight per yard. Thus, plain gray cotton sheeting may be known as a 64 square of 60s, seven yards to the pound, meaning that there are 64 threads per inch in the warp and the same in the filling of No. 60 yarn.

The more threads there are to the inch in the filling, the longer it takes to weave a fabric. Thus, if 30 days are required to weave 900 yards of 50-pick cloth, it would ordinarily require twice as long to weave the same length of 100-pick cloth. The description of the make-up of a fabric is often referred to as the "cloth organization."

596. Worsted Mill Costs.— In order to illustrate the method of accounting adapted to the needs of a textile mill, reference will be made to the mode of procedure followed in a worsted mill. Not only the forms used but also the cost accounts will be explained in detail.

597. Proved Costs.— In the operation of any cost system the plan of procedure provides for inventory accounts as explained. The proof of the cost system consists in verifying the balances by comparison with the book inventories. If the balances to the Book Inventory accounts agree with the physical inventories, a verification is obtained of the accuracy of the cost calculations and confidence is established in the cost calculations.

598. Chart of Cost Account Classifications.— The first step in introducing a cost system into a worsted mill is to departmentalize the accounts. The "Chart of Cost Account Classifications," Exhibit BC, shows what divisions are necessary to properly departmentalize all of the labor and expenses pertaining to the cost of manufacture. The inventory accounts appearing on the General Ledger are Stores, Wool, Tops, Yarn, and Worsted. Besides these accounts, there are several miscellaneous cost accounts for the dyeing, repair, power, building, general, and office expenses. The miscellaneous accounts are closed out to the Tops, Yarn, and Worsted accounts on some equitable basis of apportionment, as will be explained later. Reference to the Chart of Cost Account Classifications shows that the payroll, purchases, and stores used must be departmentalized. After all

items of labor and expenses have been segregated by operating departments, the cost of converting material into the product can be readily ascertained by referring to the departmental cost accounts. The

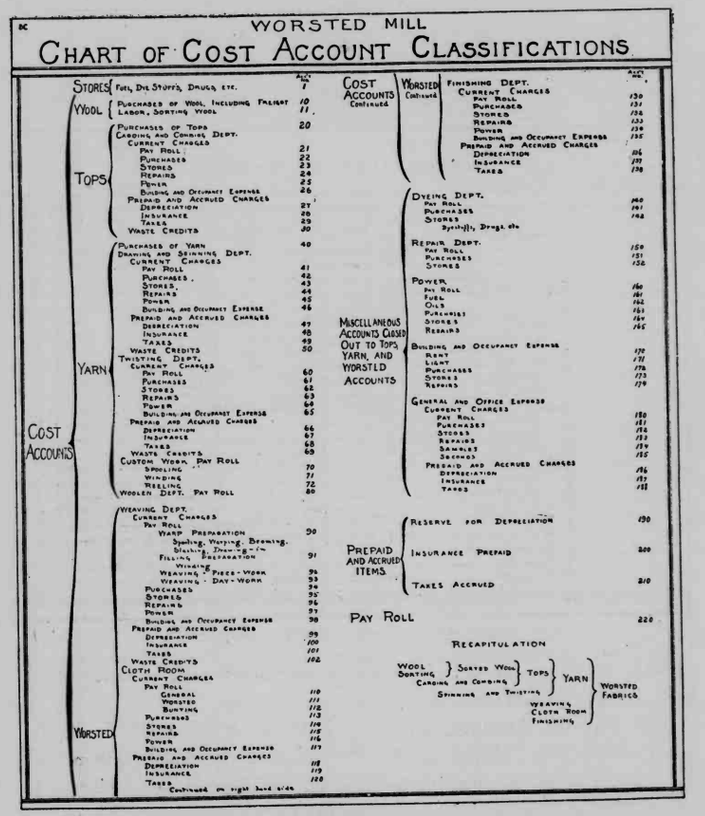


EXHIBIT BC. CHART OF COST ACCOUNT CLASSIFICATIONS

cost system provides for an analysis of costs, according to the accounts shown in Exhibit BC, at the end of each accounting period.

599. Organization Chart.— In making a complete departmentalization of the costs, one of the first accounts to be analyzed is the Payroll account. The "Organization Chart," Exhibit Q, shows

the method to be followed in dividing up the payroll. The operatives are listed according to the departments in which they work. The manufacturing departments are grouped under the four main operations of sorting wool and making tops, making yarn, making worsted, and miscellaneous, as shown. The employees who are not engaged in manufacturing activities are classified under the general and office-expense group. The greatest possible care must, of course, be exer-

148

PAY ROLL ANALYSIS SHEET

WEEKS ENDED

DEPARTMENTS	ACCT. No.	TOTAL	1ST WEEK	2ND WEEK	3RD WEEK	4TH WEEK	5TH WEEK
SORTING	11						
CARDING & COMBING	21						
DRAWING & SPINNING	41						
TWISTING	60						
CUSTOM WORK							
SPOOLING	70						
WINDING	71						
REELING	72						
WOOLEN	80						
WEAVING							
WARP PREPARATION	90						
FILLING PREPARATION	91						
WEAVING PC. WK.	92						
WEAVING DAY WK.	93						
CLOTH ROOM							
GENERAL	110						
WORSTED	111						
BUNTING	112						
FINISHING	130						
DYEING	140						
REPAIR DEPT.	150						
POWER	160						
GENERAL	180						
TOTAL PAY ROLL							

FORM 148. PAYROLL ANALYSIS SHEET

cised in making a proper classification of the payroll, in order to adhere to the cost-account classifications.

600. Payroll Analysis Sheet.— Each week the analysis of the payroll should be entered on the Payroll Analysis Sheet, Form 148. At the end of the accounting period, the sheet can be cross-footed to obtain the total payroll for each departmental account classification, in accordance with the Chart of Account Classifications. It is from Form 148, "Payroll Analysis Sheet," that the Journal entry distributing the payroll for the period to the various cost accounts is obtained.

601. Purchase Journal.— It is necessary to make a complete distribution of the purchases in accordance with the Chart of Cost Ac-

count Classifications. The Purchase Journal (Form 36) is provided for the purpose of departmentalizing all invoices which have been approved for payment. One feature of Form 36 which differs from the form of Purchase Journal frequently found in use, is the provision made for entering the pounds of material purchased. In a textile mill it is desirable to keep a complete record of the weights of material from the time purchased until shipped, in order to obtain the loss in weight of raw material from start to finish of the manufacturing process.

149

REPORT OF STORES ISSUED

TO DEPT. WEEK ENDED

QUANTITY	DESCRIPTION	PRICE	UNIT	AMOUNT

FORM 149. REPORT OF STORES ISSUED

602. Report of Stores Issued.— When supplies are purchased in large quantities and issued in small lots to the various departments, the supplies should be reported on Form 149. This is a necessary part of the accounting procedure in order that supplies may be charged to the cost of operations during the period when consumed. A corresponding credit is made to the Supplies Account in the Ledger, thus leaving a balance to the account equal to the inventory value of supplies on hand. The balance to the Supplies account is set up on the monthly Balance Sheet.

603. Cost of Sorted Wool.— Raw wool, or wool in the grease as it is called, is received in bags or bales. The wool is sorted into different grades and a new scale of values attached to each grade. Wool which is not suitable for manufacture is sold. Revenue obtained from the sale of inferior grades of wool is an offset to the original cost of the lot, and is considered when figuring the cost of sorted wool.

The plan to be followed in figuring the cost of sorted wool is to add the labor cost of sorting and washing to the cost of wool. The labor of the sorting operation, as shown on the Organization Chart (Exhibit Q), is prorated on a pound basis. Thus, if the labor in the sorting department costs one cent a pound, it would be necessary to add $286.65 to the cost of raw wool in a lot producing 28,665 pounds of grade 7. If it had been found that the top (quality 7) cost $0.75 per pound after making an allowance for burry, medium shorts, clips and strings, the addition of one cent for sorting labor would make the sorted wool used for tops cost $0.76. The price of wool should, of course, include the cost of freight. A separate book should be kept to show the cost of each lot, including the labor of sorting. Sorted wool used in tops can then be priced by referring to the proper lot number in the book mentioned.

604. Cost of Tops.— After raw wool has been sorted, the next operation is that known as carding and combing. The sorted wool is run through a series of machines called "cards" and "combs," which separate the long fibers from the short ones called "noil." Long fibers come out from the gill boxes in the form of loose strands called "tops" and are wound into balls weighing about 10 pounds each. The tops are frequently dyed before being made into yarn. Separate forms are provided for figuring the cost of white tops and dyed tops.

605. Cost of White Tops.— The plan of cost finding for white tops is to ascertain the cost of each lot separately. Sorted wool to be made into tops is laid down for each lot and the weights of wools used are reported in a book kept for the purpose. From this book the weights of sorted wool used are obtained for entry on the "Cost of Tops Sheet," Form 150. The prices at which the weights of the various lots of sorted wool are extended are obtained from the book previously mentioned.

A record is also kept of the output or yield of each lot in tops,

noils, and waste. The market value of the noil and waste is entered in the price column of Form 150 and the pounds extended. The total value of the noil and waste is deducted from the cost of sorted wool in order to find the net cost of wool.

At the end of each accounting period, a summary is made of the cost of the period's sorted wool entered on Form 150. A journal entry is then made charging the Tops account in the Ledger and crediting the Wool account. The value of the noil and waste entered on

150

COST OF TOPS
WHITE

DATE

LOT NO._____ QUALITY _____

WOOL LOT NUMBER	POUNDS	PRICE	AMOUNT
COST OF WOOL			
DEDUCT NOIL			
WASTE			
NET COST OF WOOL			
LABOR AND EXPENSE			
TOTAL COST OF WHITE TOPS			

REMARKS. PER CENT OF NOIL TO TOTAL POUNDS OF WOOL %

FORM 150. COST OF TOPS, WHITE

Form 150 for the period, is also summarized and an entry made charging the Noil and Waste account and crediting the Tops account. By this means the net cost of sorted wool used for tops is charged to the Tops account. The wool which is deducted from the Wool account in the Ledger leaves a balance equal to the inventory value of raw and sorted wool on hand at the end of the period. The balance of the Wool account appears on the Balance Sheet at the end of the period.

The labor and expense of the carding and combing operations, up to and including the gill-box operations, are charged to the Tops ac-

count, in accordance with the provisions of the Chart of Cost Account Classifications (Exhibit BC). Various qualities of tops are produced, known as 6's, 7's, 8's, 9'c, etc. No. 6 quality is finer than the higher numbers and therefore is produced at a slower rate. The higher the number the greater is the theoretical production and the less the cost of labor and expense per pound. At the end of each accounting period, the labor and expense of carding and combing, as shown by the Tops account in the Ledger, are apportioned in inverse ratio to the theoretical production of the various qualities. The method of calculation is indicated by the following table:

Quality (1)	Pounds of Tops Produced (2)	Theoretical Production (3)	Quotient (2 ÷ 3)	Multiplier (4)	Labor and Expense (5)	Labor and Expense Per Pound (5 ÷ 2)
6	10,000	300	33.3	* 42.372	$1,411	14.11 cents
7	30,000	400	75.0		3,178	10.59 cents
8	50,000	450	111.1		4,708	9.41 cents
9	10,000	500	16.6		703	7.03 cents
			236.0		$10,000	

* $10,000 ÷ 236 = 42.372.

In case certain qualities are double-combed it is necessary to take this extra operation into consideration, by allowing for an increase in cost of, say, 20 per cent for a quality which is combed twice over that which is combed but once. The production reports show the pounds of each quality double-combed.

Assume, for example, that of the No. 7 quality, 20,000 pounds were combed once, and 10,000 pounds twice. The calculation would then be as follows:

	Pounds (1)	Multiplier (2)	Product (1 × 2)	Per Cent	Cost (3)	Per Pound (3 ÷ 1)
Combed once.....	20,000	1.0	20,000	62.5	$1,986	9.93 cents
Combed twice....	10,000	1.2	12,000	37.5	1,192	11.92 cents
	30,000		32,000	100.0	$3,178	

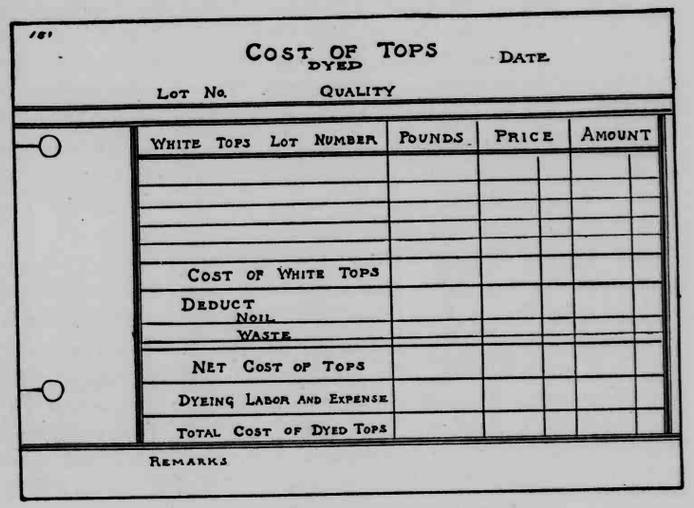
From the foregoing it is seen that the tops combed twice cost 1.99 cents more than those combed once, or an increase of 20 per cent.

The rates obtained, at the end of each accounting period, for labor

and expense per pound of tops for the various qualities are to be used for calculating the labor and expense on the Cost of Tops Sheet, Form 150. Thus, for example, if 2,000 pounds of tops were produced from Lot 100 of quality 7, combed once, the labor and expense chargeable to the lot would be (2,000 × 9.93 cents) $198.60.

At the bottom of Form 150 provision is made for showing the ratio of the noil produced to the pounds of sorted wool used.

606. Cost of Dyed Tops.— When white tops are dyed to make colored tops, the cost of the dyeing process must be added to the cost


COST OF TOPS DYED DATE
LOT NO. QUALITY

WHITE TOPS LOT NUMBER	POUNDS	PRICE	AMOUNT
COST OF WHITE TOPS			
DEDUCT NOIL			
WASTE			
NET COST OF TOPS			
DYEING LABOR AND EXPENSE			
TOTAL COST OF DYED TOPS			

REMARKS

FORM 151. COST OF DYED TOPS

of the white tops. It is necessary to establish a scale of prices for dyeing, so that the labor and expense of dyeing can be added to the cost of making the white tops. Thus, for example, if 250 pounds of colored tops are made in a lot, and it is estimated that it costs $0.20 per pound for dyeing, an additional charge of $0.50 would have to be made. The cost of each lot of tops dyed is to be figured on Form 151.

The amount of dyeing labor and expense applied during each period to the cost of tops is summarized and an entry made charging the Tops account and crediting the Dye House account. At the end of

each accounting period, summaries are made showing the average cost of each quality of white and dyed tops manufactured.

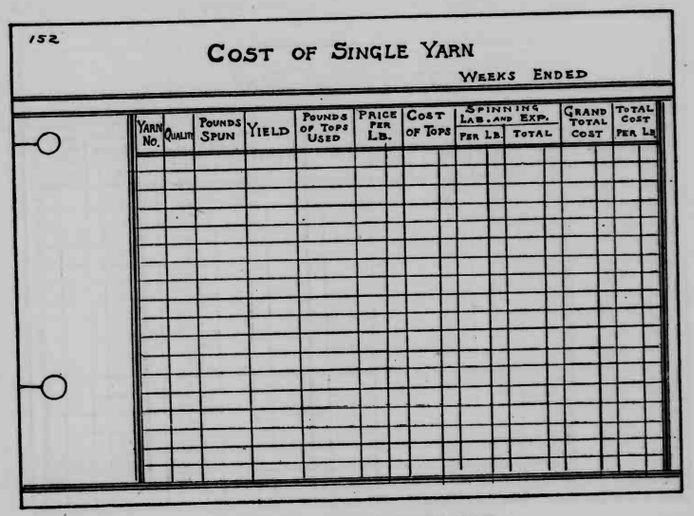
The top-making department is operated as a separate business, selling its product to the yarn-manufacturing division. The yarn cost sheet, which is explained in a subsequent section, shows the pounds of tops of the various qualities used in making yarn during each period. The pounds used are extended at the average prices for the various qualities of white and dyed tops determined upon for the period, in order to find the actual cost of tops used. At the end of each accounting period, an entry is made charging the account in the Ledger called Loss and Gain on Tops for the actual cost of tops used in making yarn and crediting the Tops account. In case tops are sold, an additional entry has to be made for them, charging the Cost of Sales account in the Ledger and crediting the Tops account at actual cost. By this means, the cost of tops consumed and sold is taken out of the Tops account so that the balance of the account shows the inventory value of tops on hand and in process of manufacture. The inventory of tops appears on the monthly Balance Sheet.

607. Cost of Making Yarn.— After making tops the next operation consists in drawing the loose strands of tops out and giving them a slight twist, thus making what is called "roving." The roving is subsequently drawn out further and given more twist on the spinning frames in order to make single yarn. Single yarn is generally used for filling yarn. The cost of tops used for making yarn is to be figured according to a price list to be adjusted each period, as experience seems to demand. The difference between the cost of tops used, when figured according to the prices thus established, and the actual cost of production for the period, represents the so-called loss or gain on making tops. By this means the efficiency of the carding and combing departments where tops are made will, to a certain extent, be determined.

A weekly production report is usually prepared, showing the number of pounds of each size and quality of yarn spun, and also the number of pounds of ply yarns twisted. The higher numbers of yarn are produced more slowly than the lower numbers because the length of yarn in a pound is longer in the former. The slower the rate of production, the higher is the labor and expense per pound. The plan is to apportion the labor and expense of the drawing and

spinning process in inverse ratio to the theoretical production, in an analogous manner to that followed in calculating the cost of various qualities of tops. Thus, for example, the labor and expense per pound for carding and spinning a No. 16 yarn might be 3.52 cents per pound, while on a No. 17 yarn, which is produced more slowly, it might be 3.75 cents per pound.

608. Cost of Single Yarn.— The average cost of each yarn number is calculated at the end of each accounting period on Form 152.


152

COST OF SINGLE YARN

WEEKS ENDED

Yarn No.	Quality	Pounds Spun	Yield	Pounds of Tops Used	Price per Lb.	Cost of Tops	Spinning Lab. and Exp. Per Lb.	Spinning Lab. and Exp. Total	Grand Total Cost	Total Cost Per Lb.

FORM 152. COST OF SINGLE YARN

The pounds of yarn produced during the period are obtained from the spinning-department production reports. There is a shrinkage in the weight of tops while undergoing the drawing and spinning operations. This shrinkage must, of course, be taken into account when figuring the pounds of tops used in making the yarn produced during each accounting period. By dividing the pounds of yarn produced by the yield, the original input of tops can be calculated. The pounds of tops used can be extended at the current prices determined upon for tops to obtain the cost of tops used in making yarn. At the end of each accounting period, an entry should be made charging the

Yarn account for the cost of tops appearing on the Cost of Yarn Sheet, Form 152, and crediting the account called Loss and Gain on Tops. This credit is an offset to the debit of the Loss and Gain on Tops account mentioned at the end of the section dealing with the cost of making tops.

Labor and expense charged to single yarn as shown by the charges to the spinning department in the Yarn Account, in accordance with the provisions of the Chart of Cost Account Classifications (Exhibit BC), are to be prorated over the different numbers of yarn. The

153

COST OF PLY YARN

WEEKS ENDED

Yarn No.	Quality	Pounds Twisted	Price	Amount	Twisting Lab. and Exp. Per Lb.	Twisting Lab. and Exp. Amount	Grand Total Cost	Total Cost Per Lb.

FORM 153. COST OF PLY YARN

basis for making the distribution is inversely proportional to the theoretical production, as previously explained. The cost of tops added to the spinning-department labor and expense gives the total cost of single yarn. This figure divided by the pounds spun of each size gives the total cost per pound for the period.

609. Cost of Ply Yarn.— Two or more single yarns are run together to make ply yarns. After doubling, the yarns are twisted in order to complete the process. Ply yarns are used for warp yarns. When ply yarns are made, the labor and expense of the doubling and

twisting operations, which are charged to the Yarn account in the Ledger in accordance with the Chart of Cost Account Classifications (Exhibit BC), must be prorated over the pounds of ply yarns produced. The basis for making the apportionment of labor and expense, is the theoretical production, as in the case of single yarn. Form 153 is designed to be used for the calculation of the cost of ply yarn. The price of single yarn is obtained from the cost sheet shown in Form 152. The sum of the cost of single yarn, and labor

154

CUSTOM YARN COSTS

OPERATION WEEKS ENDED

Yarn No.	Quality	Pounds Produced	Price of Yarn	Amount	Labor Per Lb.	Labor Amount	Grand Total Cost	Total Cost Per Lb.

FORM 154. CUSTOM YARN COSTS

and expense, gives the total cost of producing ply yarns of the various numbers for the period. The total cost divided by the pounds twisted of each size gives the average cost per pound.

610. Custom Yarn Costs.— Yarn for customers is prepared for shipment by being either wound on jack spools, reeled into skeins, or wound into truncated-cone shaped forms. When this is the case, the labor of the additional operation must be added to the cost of the single or ply yarn sold. Form 154 is designed for the purpose of calculating the cost of custom yarn. If the operation is jack spooling, the labor cost of this operation must be apportioned over the various

numbers of yarn spooled. A separate cost sheet should be used for each operation in order to obtain correct costs.

The yarn used each month for the purpose of producing the various fabrics is shown on the "Cost of Worsted Sheet," Form 155, which will be explained in a subsequent section. The actual pounds of yarn used are priced at cost, using the figures shown on the Cost of Yarn Sheets (Forms 153 and 159), and an entry made charging the Loss and Gain on Yarn account and crediting the Yarn account in

155 DATE

COST OF WORSTED

WARP No. CUTS QUALITY STYLE YDS. WOVEN YDS. FIN.

DATE	WARP YARN No.	LBS.	PRICE	AMOUNT	DATE	FILLING YARN No.	LBS.	PRICE	AMOUNT
	YARN WASTE	%				YARN WASTE	%		

LABOR AND EXPENSE		MEMO. OF COST OF CUTS SOLD
LABOR ON WARP PREPARATION, EA. @		1
LABOR ON FILLING PREPARATION ..... LBS. @		2
WEAVING LABOR, PIECE WORK ..... YDS. @		3
WEAVING DAY WORK AND EXPENSE ..... % WEAV. T.W.		4
CLOTH ROOM LABOR AND EXPENSE ..... PCS. @		5
DYEING LABOR AND EXPENSE ..... LBS. @		6
FINISHING LABOR AND EXPENSE ..... LBS. @		7
TOTAL COST OF MANUFACTURE		8
COST PER YARD FINISHED		9
		10
		11
		12

FORM 155. COST OF WORSTED

the ledger. If yarn is sold, an additional entry must be made for it, charging the Cost of Sales account in the Ledger and crediting the Yarn account, at cost. By this means, the cost of yarn consumed and sold is taken out of the Yarn account so that the balance of the Yarn account shows the inventory value of yarn on hand and in process. The inventory of yarn appears on the monthly Balance Sheet.

611. Cost of Making Worsted Fabrics.— The operation of making a worsted fabric begins with issuing an order for the preparation of the warp. The warp yarns run lengthwise of the fabric and

the filling yarns crosswise. The warp yarns are first prepared by being wound on 4 by 5-inch spools; the operation is called "spooling." These spools of warp yarn are then set up in a frame called a "creel," and from there wound on to a large reel; this operation is called "warping." The chain warps thus prepared are next wound on the beam that goes into the back of the loom; the operation being called "beaming," or "dressing." Warps are frequently passed through a bath of starch to strengthen the yarn, called "slashing." The ends in the warp have to be drawn in through the eyes in the heddles on the loom harnesses which actuate the warp threads while in the loom. It frequently happens that filling yarn has to be prepared for weaving by being wound on shuttle bobbins.

During the process of weaving, the warp yarns are raised or depressed by the operation of the harnesses, called "shedding," so that the shuttles carrying the bobbins of filling yarn can pass through the shed when driven across the loom. This operation is called "picking," because each passage of the shuttle across the loom weaves in one pick of filling. After each pick is inserted, it is shoved up into place, this operation being called "beating-up." The beam at the back of the loom with the warp then unwinds and the one on the front containing the woven fabric winds up. As soon as a piece of fabric, or "cut," as it is called, has been woven, it is cut off from the warp and the weaver is given credit for it.

After the weaving operation has been completed, the pieces of fabric are taken to the clothroom where they are weighed, measured, and inspected. The operation of inspecting worsteds and pulling the weaver's knots through the fabric is called "burling." Menders make such repairs as are necessary, the operation being performed by perchers. In the case of worsted bunting, both the inspecting and mending operations are done by the same operative.

Each piece of worsted passes through the wet and dry finishing processes before it is ready for shipment. During the fulling process, the worsted shrinks considerably so that the finished yards are less than the woven yards. In some cases worsted fabrics are dyed in the piece.

The plan followed in getting the cost of making worsted fabrics requires the preparation of a Cost of Worsted Sheet (Form 155) as soon as each warp is reported produced. All information pertaining

to the weight of warp is obtained from the warp ticket which is sent to the superintendent of weaving upon delivery of a warp to the weaving department. Reference to a book in the superintendent's office showing the organizations of the various fabrics can be made to ascertain what proportion each number of yarn used bears to the total weight of warp. From the data thus obtained, the weights of warp yarn used are entered on the Cost of Worsted Sheet (Form 155). After a cut, or piece of goods, is taken from the warp, it is sent to the clothroom where it is weighed and the weight entered on a piece ticket which is sent to the superintendent of weaving. The difference between the weight of the piece and the proportion of the warp in one piece is the weight of filling used. The warp and filling yarn used should be priced according to the scale determined upon for yarn.

At the end of each accounting period, a summary is made of the cost of yarn used, as shown by Form 155, and an entry made charging the Worsted account in the Ledger and crediting the Loss and Gain on Yarn account. This entry is an offset to the last one described under the section on "Cost of Making Yarn."

The operations known as spooling, warping, beaming, slashing, and drawing-in or twisting-in, are for the purpose of preparing warp yarn for the looms. The labor cost of preparing warps is more for wide warps, because of the greater number of ends, than it is for the narrow ones. If it is estimated that the labor on the wide warps, due to the larger number of yarns, is twice as much as that on the narrow warps, the labor of preparing warps can be assessed accordingly when figuring worsted costs.

A small quantity of filling yarn is wound on shuttle bobbins. The pounds of filling yarn wound divided into the labor cost of the operation for the period gives the rate per pound for figuring the cost of preparing filling yarn.

Weaving labor is paid for at piecework rates so the cost of it can be figured easily, when calculating the cost of a fabric on Form 155. In addition to piecework, there is day-work in the weaveroom and also weaving expense to be applied to the different fabrics. As the piecework rates are fixed in proportion to the time required to weave the various fabrics, it is fair to apportion the overhead on the basis of the direct labor. Thus, if in the weaveroom the piecework payroll for the period is shown to be $1,000 and the day labor and expense is $800, it is necessary to add 80 per cent to the piecework labor cost on the Cost of Worsted Sheet (Form 155) to find the overhead expense chargeable to the job.

The labor and expense in the clothroom is apportioned over worsted on the basis of the number of pieces handled. A relatively higher rate is established for worsted than bunting, because of the greater amount of time spent on a piece of worsted than on a piece of bunting. The cost of piece dyeing is assessed at a rate per pound when fabrics are dyed in the piece. The labor and expense of finishing is prorated on the basis of pounds, as this seems to be the most equitable method.

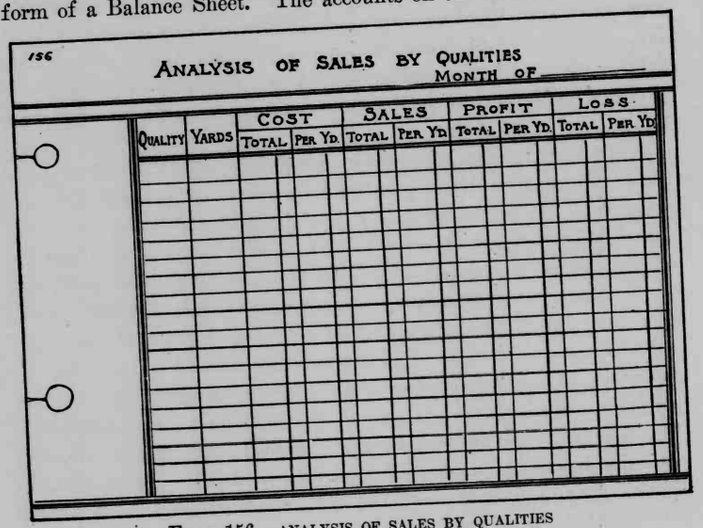
After a warp has been woven completely, the Cost of Worsted Sheet (Form 155) is compiled and the total cost per finished yard calculated. It is not necessary to wait until the books have been closed and the operation costs figured in order to make a calculation of the cost of worsted fabrics. The experience for the preceding month can be used as a guide in figuring unit costs for the various operations which appear on the Cost of Worsted Sheet (Form 155).

Reference to this Cost of Worsted Sheet gives the cost of fabrics after they have been manufactured. These cost figures are used for pricing the sales in order to compute the cost of sales for each month. In case a fabric has not been figured, due to the fact that the weaving operation has not been completed, an estimated price can be obtained by referring to another cost sheet for a similar quality. A memorandum of the price used can be made on the cost sheet for the particular cut and an adjustment made later.

The total cost of all pieces sold is to be credited to the Worsted account and charged to the Cost of Sales account at the end of each month. The balance then left in the Worsted account represents the inventory value of worsted on hand and in process of manufacture and is set up on the monthly Balance Sheet.

612. Analysis of Sales by Qualities.— After the sales for the month have been all priced an "Analysis of Sales by Qualities Sheet," Form 156, should be filled out to accompany the profit and loss statement. Form 156 shows the profit or loss in manufacturing each quality sold during the period. Provision is made for several statistical columns which show costs, sales, profits and losses per yard.

The closing of the books must now be considered. On the bookkeeper's trial balance, the balances of the Stores, Wool, Tops, Yarn, and Worsted accounts represent the respective inventory values. Provision should be made for setting up all prepaid and accrued items such as insurance, taxes, and depreciation. Then the assets and liabilities appearing on the trial balance can be arranged in the form of a Balance Sheet. The accounts on the trial balance repre-


156

ANALYSIS OF SALES BY QUALITIES

MONTH OF

Quality	Yards	Cost		Sales		Profit		Loss	
		Total	Per Yd.	Total	Per Yd.	Total	Per Yd.	Total	Per Yd.

FORM 156. ANALYSIS OF SALES BY QUALITIES

senting losses or gains, such as cost of sales, commissions, sales, interest, and so on, can be set up in the form of a profit and loss statement. After this has been done, the balances of all the profit and loss accounts should be closed out to the Profit and Loss account.

613. Cost Accounts.— To illustrate the operation of the cost accounts referred to in previous sections of this chapter, a complete set of *pro forma* cost accounts is herewith given.

STORES

Dr.						*Cr.*
1	Inventory	$20,000.00	31	Sundries		$13,050.00
31	Purchases	3,000.00	31	Balance, inventory		9,950.00
		$23,000.00				$23,000.00
1	Balance, brought down	$ 9,950.00				

All supplies, fuel, dyestuffs, drugs, chemicals, and so on, which are not consumed during the period when purchased, are charged to the stores account. At the end of each accounting period, an entry is made crediting the account for the supplies consumed and charging the proper expense accounts. The balance of the account represents the inventory value of the stores on hand at the end of the period and is set up on the Balance Sheet as an asset.

WOOL

Dr.						*Cr.*
1	Inventory of wool	$400,000.00	31	Sorted wool used for tops		$ 50,000.00
31	Purchases of wool	100,000.00	31	Balance, inventory		451,000.00
	Labor, sorting and washing	1,000.00				
		$501,000.00				$501,000.00
1	Balance, brought down	$451,000.00				

At the end of each month, the cost of sorted wool used for making tops as shown by the Cost of Tops Sheets, Form 150, is summarized and an entry made crediting the Wool account in the Ledger and charging the Tops account. The balance remaining in the account represents the inventory value of wool on hand, and appears on the Balance Sheet.

TOPS

Dr.						*Cr.*
1	Inventory of tops	$150,000.00	31	Cost of tops used		$ 60,000.00
31	Purchases of tops	10,000.00		Noil and Waste		1,000.00
	Sorted wool used	50,000.00	31	Balance, inventory		159,908.00
	CARDING AND COMBING DEPARTMENT					
	Current Charges					
	Payroll	3,000.00				
	Purchases	500.00				
	Stores	200.00				
	Repairs	100.00				
	Power	2,000.00				
	Building and Occupancy	1,000.00				
	General and Office	808.00				
	Dyeing	2,000.00				
	Prepaid and Accrued Charges					
	Depreciation	1,000.00				
	Insurance	200.00				
	Taxes	100.00				
		$220,908.00				$220,908.00
1	Balance, brought down	$159,908.00				

Dr. LOSS AND GAIN ON TOPS *Cr.*

31	Actual cost of tops used	$60,000.00	31	Estimated cost of tops used	$60,500.00
31	Balance	500.00			
		$60,500.00			$60,500.00
			1	Balance, brought down	$ 500.00
	[A debit balance represents a loss on tops.]			[A credit balance represents a gain on tops.]	

Dr. YARN *Cr.*

1	Inventory of yarn	$100,000.00	31	Cost of yarn used	$ 75,000.00
31	Purchases of yarn	25,000.00	31	Balance, inventory of yarn	128,402.00
	Cost of tops used	60,500.00			
	DRAWING AND SPINNING LABOR AND EXPENSE				
	Current Charges				
	Payroll	5,000.00			
	Purchases	200.00			
	Stores	100.00			
	Repairs	100.00			
	Power Expense	2,500.00			
	Building and Occupancy Expense	1,250.00			
	General and Office	865.00			
	Prepaid and Accrued Charges				
	Depreciation	1,500.00			
	Insurance	100.00			
	Taxes	50.00			
	TWISTING LABOR AND EXPENSE				
	Current Charges				
	Payroll	2,000.00			
	Purchases	500.00			
	Stores	100.00			
	Repairs	100.00			
	Power	1,000.00			
	Building and Occupancy Expense	500.00			
	General and Office	462.00			
	Prepaid and Accrued Charges				
	Depreciation	500.00			
	Insurance	50.00			
	Taxes	25.00			
	Miscellaneous Charges				
	Custom Spooling, Winding and Reeling	1,000.00			
		$203,402.00			$203,402.00
	Balance, brought down	$128,402.00			

At the end of each accounting period, the carding and combing department labor and expense is apportioned over the tops produced, of the various qualities, in inverse ratio to the theoretical production and added to the cost of sorted wool. The actual cost of tops used in making yarn is credited to the Tops account at the end of each period, a corresponding charge being made to the Loss and Gain on Tops account.

At the end of each accounting period, the actual cost of tops used is taken out of the Tops account, and charged to the Loss and Gain on Tops account. The offsetting entry is obtained by crediting the Loss and Gain on Tops account for the estimated cost of tops used in making the yarn produced.

If the actual cost of tops used exceeds the estimated cost, there will be a debit balance to the account. But if the estimated cost of tops exceeds the actual cost, a credit balance will remain. A debit balance to the account represents a loss, while a credit balance represents a gain.

At the end of each accounting period, the balance of the Loss and Gain on Tops account is closed out to Profit and Loss.

The cost of tops used in making yarn, as shown on the Cost of Yarn Sheet (Form 152), is charged to the Yarn account in the Ledger at the close of each accounting period, the credit being made to the Loss and Gain on Tops account.

Dr. LOSS AND GAIN ON YARN *Cr.*

31	Actual cost of yarn used	$75,000.00	31	Estimated cost of yarn used	$76,000.00
31	Balance	1,000.00			
		$76,000.00			$76,000.00
			1	Balance, brought down	$ 1,000.00
	[A debit balance represents a loss on yarn.]			[A credit balance represents a gain on yarn.]	

At the end of each accounting period, the total cost of yarn consumed in making worsted is ascertained by multiplying the pounds of the various numbers of yarn used by the cost price. The account is then credited for the total cost of yarn used, a corresponding charge being made to the Loss and Gain on Yarn account. The balance of the account represents the inventory value of yarn at the end of the period, and is so set up on the Balance Sheet.

At the end of each accounting period, the actual cost of yarn used is taken out of the Yarn account and charged to the Loss and Gain on Yarn account. The offsetting entry is obtained by crediting the Loss and Gain on Yarn account for the estimated cost of yarn used in making worsted.

If the actual cost of yarn used exceeds the estimated cost, it indicates a loss, while an excess in the estimated cost over the actual cost indicates a gain. The balance to the Loss and Gain account is closed out to Profit and Loss at the end of each period.

Dr. WORSTED *Cr.*

1	Inventory	$375,000.00	31	Cost of sales	$150,000.00
31	Cost of yarn used	76,000.00	31	Balance, inventory of worsted	347,805.00
	WEAVING DEPARTMENT LABOR AND EXPENSE				
	Current Charges				
	Payroll:				
	Warp preparation:				
	Spooling, warping, Beaming, slashing, drawing-in.	1,000.00			
	Filling preparation:				
	Winding	250.00			
	Weaving, piecework.	10,000.00			
	Weaving, day work.	2,500.00			
	Purchases	1,000.00			
	Stores	200.00			
	Repairs	100.00			
	Power	3,000.00			
	Building and Occupancy Expense	1,500.00			
	General and Office	1,788.00			
	Prepaid and Accrued Charges				
	Depreciation	2,000.00			
	Insurance	200.00			
	Taxes	100.00			
	CLOTH ROOM LABOR AND EXPENSE				
	Current Charges				
	Payroll:				
	General, Worsted, Bunting	3,000.00			
	Purchases	200.00			
	Stores	100.00			
	Repairs	100.00			
	Power	500.00			
	Building and Occupancy Expense	250.00			
	General and Office	346.00			
	Carried Forward	$479,134.00		*Carried Forward*	$497,805.00

Dr. WORSTED — *Continued* *Cr.*

	Brought Forward	$479,134.00		*Brought Forward*	$497,805.00
	Prepaid and Accrued Charges				
	Depreciation	200.00			
	Insurance	50.00			
	Taxes	20.00			
	FINISHING DEPARTMENT LABOR AND EXPENSE				
	Current Charges				
	Payroll	6,500.00			
	Purchases	2,000.00			
	Stores	3,500.00			
	Repairs	100.00			
	Power	1,000.00			
	Building and Occupancy Expense	500.00			
	General and Office	1,501.00			
	Dyeing	2,000.00			
	Prepaid and Accrued Charges				
	Depreciation	1,000.00			
	Insurance	200.00			
	Taxes	100.00			
		$497,805.00			$497,805.00
1	Balance, brought down	$347,805.00			

The cost of yarn used in making worsted, during each period, is obtained by summarizing the cost of warp and filling yarn entered on the Cost of Worsted Sheet (Form 155); a charge is then made to the Worsted account, a corresponding entry being made to the credit of the Loss or Gain on Yarn account.

At the end of each accounting period, the cost of pieces sold is determined by pricing the pieces sold at the cost shown by the Cost of Worsted Sheet, Form 155. The total cost of sales is credited to the Worsted account, a corresponding debit being made to the Cost of Sales account. The balance of the Worsted account at the end of the period represents the inventory value of worsted, and is set up on the Balance Sheet.

Dr. NOIL AND WASTE *Cr.*

31	Noil and waste produced while making tops	$1,000.00			

At the end of each accounting period the value of the noil and waste entered on the Cost of Tops Sheet, Forms 150 and 151, is

credited to the Tops account and charged to the Noil and Waste account in the Ledger. When noil and waste are sold, a credit is made to the account. The balance of the account is set up on the monthly Balance Sheet.

Dr.	Sales		Cr.
31 Profit and Loss.....		31 Net Sales	$200,000.00

The net sales shown by the account sales rendered to the factory at the end of each month are credited to the Sales account. The account is closed out to Profit and Loss.

Dr.	Cost of Sales		Cr.
31 Net cost of sales.....	$150,000.00	31 Profit and Loss.....	

The actual cost of the pieces of fabric sold, as found by pricing the individual sales at cost, is charged to the Cost of Sales account. The account is closed out to Profit and Loss.

Dr.	Accounts Receivable		Cr.
31 Sales	$200,000.00		

At the end of each month the sales are journalized and charged to Accounts Receivable account.

Dr.	Dyeing Department Labor and Expense Account		Cr.
31 Payroll	$1,200.00	31 Sundries	$4,000.00
Purchases	500.00		
Stores — dyestuffs	2,300.00		
	$4,000.00		$4,000.00

The payroll of the dyeing department and the cost of all dyestuffs and drugs used in dyeing are charged to this account. At the end of each accounting period, the labor and expense of dyeing tops is charged to the carding and combing department, and the labor and expense of dyeing pieces is charged to the Worsted account.

Dr.	Repair Department Labor and Expense Account		Cr.
31 Payroll	$250.00	31 Sundries	$600.00
Purchases	200.00		
Stores	150.00		
	$600.00		$600.00

The payroll of the carpenters and machinists, together with the cost of any repair parts and purchases incidental to making repairs, are charged to this account. At the end of each accounting period, the account is credited for the repairs made for the various departments. It is likely that the account may be operated so as to have a balance at the end of each period, due to the stock of repair parts remaining on hand.

Dr.	Power Expense		Cr.
31 Payroll	$ 2,000.00	31 Sundries	$10,000.00
Purchases	2,000.00		
Fuel	5,500.00		
Oils	100.00		
Stores (Supplies).....	400.00		
Repairs			
	$10,000.00		$10,000.00

The fuel used and all expenses incident to the operation of the power plant are charged to this account. At the end of each accounting period, the account is closed out to the various operating-department accounts on the basis of the horsepower used by each.

Dr.	Building and Occupancy Expense		Cr.
31 Rent	$4,000.00	31 Sundries	$5,000.00
Light	200.00		
Purchases	500.00		
Stores	300.00		
	$5,000.00		$5,000.00

The rent and all the expenses that are incidental to occupying the plant are chargeable to this account. At the end of each accounting period, the account is closed out to the various operating-department accounts on the basis of the floor space occupied.

Dr.	General and Office Expense		Cr.
Current Charges		31 Sundries	$5,770.00
31 Payroll	$5,000.00		
Purchases	500.00		
Stores	100.00		
Prepaid and Accrued Charges			
Depreciation	100.00		
Insurance	50.00		
Taxes	20.00		
	$5,770.00		$5,770.00

All expenses which cannot be charged directly to one of the operating-department accounts, or to a service department, are charged to General Expense. All expenses incurred in connection with running the office are combined with general expenses. Any revenue obtained from the sale of waste, unless allocated to departments, is credited to General Expense. At the end of each accounting period the balance to the account is closed out to the various operating-departments on the basis of the total labor and expense charges made to each.

Dr. RESERVE FOR DEPRECIATION *Cr.*

			Sundries	$6,300.00

The estimated amount of depreciation on the plant each period is credited to this account and charged to the General Expense and various operating-department accounts.

Dr. INSURANCE PREPAID *Cr.*

31	Premiums paid for insurance	$5,000.00	31	Sundries	$ 850.00
			31	Balance, unexpired portion of insurance premium	4,150.00
		$5,000.00			$5,000.00
1	Balance, brought down	$4,150.00			

All insurance premiums which are purchased are charged to this account. The amount of the insurance premiums which expire each period are credited to this account, and the various department expense accounts charged. The insurance on the equipment is apportioned on the basis of valuation. Insurance on stock should be charged to General Expense. Liability insurance is apportioned on the basis of the payroll of the various departments.

Dr. TAXES PREPAID *Cr.*

31	Taxes Paid	$3,000.00	31	General and Office Expense	$ 415.00
			31	Balance	2,585.00
		$3,000.00			$3,000.00
1	Balance, brought down	$2,585.00			

A prorated allowance should be made for property taxes each period, by making a charge to General Expense and a credit to the

Taxes Accrued account. The amount can be ascertained by taking the tax bills of the preceding year as a basis and then making an adjustment when the bills for the current year are received.

Dr. PAYROLL ACCOUNT *Cr.*

3	Cash		31	Sundries	$43,700.00
10	Cash				
17	Cash				
24	Cash				
31	Cash				

Payroll checks are entered in the Cash Book and charged to the Payroll account. At the end of each accounting period the payroll is analyzed and closed out to the various departmental expense accounts.

Dr. ACCOUNTS PAYABLE *Cr.*

			31	Sundries	$158,300.00

The total of the vouchers entered in the Purchase Journal (Form 150) are credited to this account at the end of the month.

Dr. SURPLUS *Cr.*

			1	Balance	$1,045,000.00

The trial balance taken from the preceding *pro forma* cost accounts is as follows:

TRIAL BALANCE

	Debit Balances	Credit Balances
Stores	$ 9,950.00	
Wool	451,000.00	
Tops	159,908.00	
Loss and Gain on Tops		$ 500.00
Yarn	128,402.00	
Loss and Gain on Yarn		1,000.00
Worsted	347,805.00	
Noil and Waste	1,000.00	
Sales		200,000.00
Cost of Sales	150,000.00	
Accounts Receivable	200,000.00	
Reserve for Depreciation		6,300.00
Insurance Prepaid	4,150.00	
Taxes Prepaid	2,585.00	
Payroll		43,700.00
Accounts Payable		158,300.00
Surplus		1,045,000.00
	$1,454,800.00	$1,454,800.00

614. Journal Entries.— A number of sources contribute the data required to make the necessary Journal entries for posting to the various cost accounts. The following schedules indicate what data must be obtained for the purpose of making the Journal entries. The schedules are intended as a reminder to the bookkeeper so that none of the entries will be overlooked at the end of the month.

SCHEDULE 1. OPENING INVENTORY

Stores (Supplies)	$ 20,000.00
Wool	400,000.00
Tops	150,000.00
Yarn	100,000.00
Worsted	375,000.00
Total	$1,045,000.00

Cost accounts are opened at the beginning of an accounting period with an inventory of all stock on hand.

SCHEDULE 2. PAYROLL ANALYSIS

Wool, Sorting	$ 1,000.00
Tops, Carding and Combing	3,000.00
Yarn, Drawing and Spinning	5,000.00
Yarn, Twisting	2,000.00
Yarn, Custom Work:	
Spooling	500.00
Winding	200.00
Reeling	300.00
Worsted, Warp Preparation	1,000.00
Worsted, Filling Preparation	250.00
Worsted, Weaving Piece Work	10,000.00
Worsted, Weaving Day Work	2,500.00
Worsted, Cloth Room	3,000.00
Worsted, Finishing Department	6,500.00
Worsted, Dyeing Department	1,200.00
Worsted, Repair Department	250.00
Worsted, Power Department	2,000.00
Worsted, General and Office	5,000.00
	$43,700.00

This schedule is prepared from the Payroll Analysis Sheet (Form 148) as a basis for making a distribution of the payroll to the various cost accounts.

SCHEDULE 3. ANALYSIS OF PURCHASES

Insurance	$ 5,000.00
Taxes (Property)	3,000.00
Stores	3,000.00
Wool	100,000.00
Tops	10,000.00
Tops, Carding and Combing	500.00
Yarn	25,000.00
Yarn, Drawing and Spinning	200.00
Yarn, Twisting	500.00
Worsted, Weaving	1,000.00
Worsted, Cloth Room	200.00
Worsted, Finishing Department	2,000.00
Dyeing Department	500.00
Repair Department	200.00
Power	2,000.00
Building and Occupancy	500.00
Rent	4,000.00
Light	200.00
General and Office	500.00
Total Purchases	$158,300.00

This schedule is prepared from the Purchase Journal (Form 36) as a means of departmentalizing the costs.

SCHEDULE 4. STORES ISSUED

Tops, Carding and Combing	$ 200.00
Yarn, Drawing and Spinning	100.00
Yarn, Twisting	100.00
Worsted, Weaving	200.00
Worsted, Cloth Room	100.00
Worsted, Finishing Department	3,500.00
Dyeing Department	2,300.00
Repair Department	150.00
Power Department:	
Fuel	5,500.00
Oils	100.00
Supplies	400.00
Building and Occupancy	300.00
General and Office	100.00
Total Stores Issued	$13,050.00

This schedule is prepared from the Report of Stores Issued (Form 149) as a means of distributing the stores issued to departments during the month.

SCHEDULE 5. DISTRIBUTION OF REPAIRS

Tops, Carding and Combing	$100.00
Yarn, Drawing and Spinning	100.00
Yarn, Twisting	100.00
Worsted, Weaving	100.00
Worsted, Cloth Room	100.00
Worsted, Finishing Department	100.00
Total Repairs	$600.00

This schedule shows the distribution of repairs as a means of closing the Repair Department Labor and Expense account out to operating-department accounts at the end of the month.

SCHEDULE 6. DISTRIBUTION OF POWER

Tops, Carding and Combing	$ 2,000.00
Yarn, Drawing and Spinning	2,500.00
Yarn, Twisting	1,000.00
Worsted, Weaving	3,000.00
Worsted, Cloth Room	500.00
Worsted, Finishing	1,000.00
Total Power	$10,000.00

This schedule shows the distribution of power as a means for closing the Power Expense account out to operating department accounts at the end of the month.

SCHEDULE 7. DISTRIBUTION OF BUILDING AND OCCUPANCY EXPENSE

Tops, Carding and Combing	$1,000.00
Yarn, Drawing and Spinning	1,250.00
Yarn, Twisting	500.00
Worsted, Weaving	1,500.00
Worsted, Cloth Room	250.00
Worsted, Finishing	500.00
Total	$5,000.00

This schedule shows the distribution of building and occupancy expense as a means of closing the Building and Occupancy Expense account out to the operating-department accounts at the end of the month.

SCHEDULE 8. DISTRIBUTION OF DEPRECIATION

Tops, Carding and Combing	$1,000.00
Yarn, Drawing and Spinning	1,500.00
Yarn, Twisting	500.00
Worsted, Weaving	2,000.00
Worsted, Cloth Room	200.00
Worsted, Finishing	1,000.00
General and Office	100.00
Total Depreciation	$6,300.00

This schedule shows the apportionment of depreciation to operating-department accounts at the end of the month.

SCHEDULE 9. DISTRIBUTION OF INSURANCE

Tops, Carding and Combing	$200.00
Yarn, Drawing and Spinning	100.00
Yarn, Twisting	50.00
Worsted, Weaving	200.00
Worsted, Cloth Room	50.00
Worsted, Finishing	200.00
General and Office	50.00
Total Insurance	$850.00

This schedule shows the distribution of insurance to operating departments at the end of the month.

SCHEDULE 10. DISTRIBUTION OF TAXES

Tops, Carding and Combing	$100.00
Yarn, Drawing and Spinning	50.00
Yarn, Twisting	25.00
Worsted, Weaving	100.00
Worsted, Cloth Room	20.00
Worsted, Finishing	100.00
General and Office	20.00
Total Taxes	$415.00

This schedule shows the distribution of taxes for the period to operating-department accounts.

SCHEDULE 11. APPORTIONMENT OF DYEING DEPARTMENT EXPENSE

Tops	$2,000.00
Worsted	2,000.00
Total Dyeing	$4,000.00

This schedule shows the distribution of dyeing-department expense to tops and worsted at the end of the month.

SCHEDULE 12. APPORTIONMENT OF GENERAL EXPENSE

Tops, Carding and Combing, 14 per cent	$ 808.00
Yarn, Drawing and Spinning, 15 per cent	865.00
Yarn, Twisting, 8 per cent	462.00
Worsted, Weaving, 31 per cent	1,788.00
Worsted, Cloth Room, 6 per cent	346.00
Worsted, Finishing, 26 per cent	1,501.00
Total General Expense, 100 per cent	$5,770.00

This schedule shows the apportionment of general and office expense to the operating-department accounts on the basis of direct charges made to operating-department accounts at the end of the month.

SCHEDULE 13. COST OF MATERIAL

Dr. Tops	$50,000.00	
Cr. Wool		$50,000.00
[Cost of tops used as per Cost of Tops Sheet, Form 150.]		
Dr. Noil and Waste	1,000.00	
Cr. Tops		1,000.00
Dr. Loss and Gain on Tops	60,000.00	
Cr. Tops		60,000.00
[Actual cost of tops used in making yarn per yarn cost calculations.]		
Dr. Yarn	60,500.00	
Cr. Loss and Gain on Tops		60,500.00
[Estimated cost of tops used in making yarn.]		
Dr. Loss and Gain on Yarn	75,000.00	
Cr. Yarn		75,000.00
[Actual cost of yarn used in making worsted.]		
Dr. Worsted	76,000.00	
Cr. Loss and Gain on Yarn		76,000.00
[Estimated cost of yarn used in making worsted.]		
Dr. Cost of Sales	150,000.00	
Cr. Worsted		150,000.00
[Cost of worsted sold.]		
Dr. Accounts Receivable	200,000.00	
Cr. Sales		200,000.00

615. Summary.— The textile industry is highly technical and in order to figure the cost of yarn, and woven and knit goods intelligently one must understand to some degree the manufacturing processes. The making of yarn is carried on as a process and the cost of yarn figured in accordance with the principles of process cost accounting. Knit goods are also run on the process system. However, the weaving of a fabric must be done according to particular designs and so special instructions have to be issued. Woven fabrics fall in the job-order class. Finishing processes in the textile industry are usually figured as continuous processes.

QUESTIONS ON CHAPTER XLIII

1. Name the principal textile fibers of commerce.
2. What are the principal operations in making yarn, woven, and knit fabrics?
3. How are yarns numbered? Illustrate.
4. What is the general plan of procedure followed in figuring costs in a worsted mill?
5. Describe the principal cost accounts in a worsted mill.
6. What Journal entries are required to close the cost accounts in a worsted mill?

CHAPTER XLIV

PROBLEM IN PROCESS COSTS, WITH SOLUTION

616. Silk-Mill Costs.— In order to present more fully the bookkeeping procedure involved in the operation of a system of process cost accounts, reference will be made to a silk-throwing mill. The problem of process costs is here somewhat simplified because the throwing mill does not own the raw silk, and so we have to account only for the cost of the processes involved in transforming raw silk into tram (filling) and organzine (warp). The expense of conversion is apportioned on a pound basis. The procedure will be understood readily from the following problem and solution. The various steps involved in operating the cost accounts are presented in considerable detail in order that the reader shall not fail to grasp the plan. In actual practice some of the steps can be short-circuited. In lieu of the books of original entry the necessary data for making the cost calculations are presented in several schedules.

617. Problem.— From the data contained in the following schedules open the cost accounts for a silk-throwing mill, make the necessary Journal entries, and, after closing the accounts, prepare an analysis of the cost of production and a profit and loss statement.

SCHEDULE 1

WORK IN PROCESS, JANUARY 1, 1920

Operation	Pounds	Price, Cents	Amount
Soaking tram	759	2.572	$ 19.52
Soaking organzine	1,679	2.572	43.19
Winding tram	537	8.511	45.70
Winding organzine	1,435	8.511	122.14
Spinning tram	112	4.401	4.93
Spinning organzine	691	11.402	78.79
Total			$314.27

The foregoing schedule shows the value of work in process apportioned among the various processes. It will be noticed that there are

SCHEDULE 2

PURCHASES FOR JANUARY 31, 1920

Direct charges:	
Soaking tram	$48.70
Soaking organzine	93.30
Reeling tram	7.24
Reeling organzine	10.00
Freight, tram	20.11
Freight, organzine	37.17
Operating expense:	
Repairs and renewals	123.40
Fuel	353.65
Office expense:	
Postage	42.00
Stationery and office supplies	28.03
Total	$763.60

SCHEDULE 3

PAYROLL ANALYSIS FOR JANUARY, 1920

Direct charges:	
Soaking tram	$ 32.47
Soaking organzine	62.25
Winding tram	174.13
Winding organzine	327.45
Spinning tram	174.83
Spinning organzine	338.46
Reeling tram	99.06
Reeling organzine	187.62
Shipping tram	8.50
Shipping organzine	16.00
Operating expense:	
Wages:	
Superintendent	91.00
Machinist	73.72
Watchman	56.62
Engineer and fireman	89.45
General help	181.46
Office expense:	
Wages	45.00
Total	$1,958.02

more pounds of tram to be charged for the soaking process than for the winding process. This is because not all tram that has been soaked has been wound. It also appears that all tram that has been wound has not been spun. Of the tram in process, 759 pounds has been soaked, 537 pounds wound, and 112 pounds spun, as shown. A similar condition prevails in respect to the soaking, winding, and spinning of the organzine.

The information contained in the schedule of purchases (Schedule 2) is taken from the voucher record in which all purchases are recorded.

The third schedule shows the payroll for the month analyzed ready for entry on the cost records.

SCHEDULE 4

FIXED CHARGES FOR JANUARY, 1920

Operating expense:	
Depreciation on buildings	$138.53
Depreciation on machinery and equipment	419.90
Office expense:	
Depreciation on office equipment	2.20
General expense:	
Insurance	56.51
Taxes	5.00
New York Office	300.00
Total	$920.14

Each month an estimate of the fixed charges has to be made as shown in the foregoing schedule.

SCHEDULE 5

INVENTORY OF WORK IN PROCESS, JANUARY 31, 1920

Operation	Pounds
Soaking tram	807
Soaking organzine	1,783
Winding tram	543
Winding organzine	1,418
Spinning tram	218
Spinning organzine	547

The inventory of work in process at the end of the period is made as shown in the above schedule.

Tram is to be charged for the following costs: soaking, winding, spinning, reeling, shipping, operating expense, office expense, and general expense.

Organzine is to be charged for the following costs: soaking, winding, spinning, reeling, shipping, operating, office, and general expense.

In making the apportionment of operating expense to the cost of goods sold, one pound of organzine is to be charged six times as much as one pound of tram, because of the greater time involved in processing the former.

Office expense is to be apportioned to tram and organzine on the basis of pounds sold.

General expense is also to be apportioned to tram and organzine on the basis of pounds sold.

SCHEDULE 6

SALES FOR JANUARY, 1920

Tram,	1,656 lb. @ $0.60	$ 993.60
Organzine,	3,079 lb. @ 1.00	3,079.00
		$4,072.60

Information contained in the above schedule is obtained from the sales book at the end of the period.

SOLUTION

JOURNAL ENTRIES

Work in Process, January 1, 1920

Dr.	Soaking — Tram	$ 19.52	
	Soaking — Organzine	43.19	
	Winding — Tram	45.70	
	Winding — Organzine	122.14	
	Spinning — Tram	4.93	
	Spinning — Organzine	78.79	
	Cr. Surplus		$ 314.27

This Journal entry puts the initial inventory of work in process on the Ledger.

The following Journal entry sets up the liability incurred on account of purchases during the month under consideration chargeable to the cost accounts.

Purchases for January, 1920

Dr.	Soaking — Tram	$ 48.70	
	Soaking — Organzine	93.30	
	Reeling — Tram	7.24	
	Reeling — Organzine	10.00	
	Shipping Freight — Tram	20.11	
	Shipping Freight — Organzine	37.17	
	Operating expense:		
	Repairs and renewals	123.40	
	Fuel	353.65	
	Office expense:		
	Postage	42.00	
	Stationery and office supplies	28.03	
	Cr. Accounts Payable		$ 763.60

Payroll for January, 1920

Dr.	Soaking — Tram	$ 32.47	
	Soaking — Organzine	62.25	
	Winding — Tram	174.13	
	Winding — Organzine	327.45	
	Spinning — Tram	174.83	
	Spinning — Organzine	338.46	
	Reeling — Tram	99.06	
	Reeling — Organzine	187.62	
	Shipping — Tram	8.50	
	Shipping — Organzine	16.00	
	Operating expense:		
	Wages:		
	Superintendent	91.00	
	Machinist	73.72	
	Watchman	56.62	
	Engineer and Fireman	89.45	
	General help	181.46	
	Office expense:		
	Wages	45.00	
	Cr. Payroll		$1,958.02

The foregoing entry distributes the payroll for the period.

Fixed Charges for January, 1920

Dr.	Operating Expense	$556.43	
	Cr. Reserve for Depreciation on Buildings		$136.53
	Reserve for Depreciation on Machinery		419.90
Dr.	Office Expense	$ 2.20	
	Cr. Reserve for Depreciation on Office Equipment		$ 2.20
Dr.	General Expense	$361.51	
	Cr. Insurance Prepaid		$ 56.51
	Taxes Accrued		5.00
	A. B. Co., New York Office expense		300.00

The three foregoing journal entries provide for debiting expense with the requisite amount of fixed charges for the period.

After all the foregoing entries have been posted to the Ledger accounts, we can proceed to figure the cost of sales and close the cost accounts. Reference to the first Ledger account, headed "Soaking — Tram," in a following section shows the method of procedure. On the debit side the charges amount to $100.69. On the credit side the inventory of work in process as per Schedule 5, amounting to 807 lb., and the production of 1,656 lb. as per Schedule 6 are shown entered. The total of these amount to 2,463 pounds. This figure is divided into the total cost of $100.69, which gives 4.008 cents as the cost per pound for the soaking process. The inventory and the cost of sales are priced at this figure and extended as shown. The same procedure is followed with regard to the other cost accounts where there are inventories.

When it comes to reeling, shipping, operating, office, and general expense, no inventories are encountered, and so the unit cost per pound is calculated by simply dividing the production into the total charges to the account as shown. In making the apportionment of operating expense to the cost of goods sold, one pound of organzine is charged six times as much as one pound of tram, because of the greater time involved in processing the former.

We are now ready to make the following entry charging the Cost of Sales accounts and crediting the various cost accounts for the cost of production, as shown. Afterwards an entry is made charging Accounts Receivable and crediting Sales for the sales made during the period. Then finally Sales and Cost of Sales accounts are closed out to Profit and Loss, as shown.

Closing Entries

Dr. Cost of Sales — Tram			
Soaking, 1,656 lb. @ 4.088 cents	$ 67.70		
Winding, 1,656 lb. @ 9.997 cents	165.55		
Spinning, 1,656 lb. @ 9.592 cents	158.85		
Reeling, 1,656 lb. @ 6.419 cents	106.30		
Shipping, 1,656 lb. @ 1.727 cents	28.61		
Operating, 1,656 lb. @ 7.588 cents	125.66		
Office, 1,656 lb. @ 2.476 cents	41.00		
General, 1,656 lb. @ 7.635 cents	126.43		
Cost of Sales — Organzine			
Soaking, 3,079 lb. @ 4.085 cents	$ 125.85		
Winding, 3,079 lb. @ 9.997 cents	307.83		
Spinning, 3,079 lb. @ 11.507 cents	354.31		
Reeling, 3,079 lb. @ 6.419 cents	197.62		
Shipping, 3,079 lb. @ 1.727 cents	53.17		
Operating, 3,079 lb. @ 45.530 cents	1,400.07		
Office, 3,079 lb. @ 2.476 cents	76.23		
General, 3,079 lb. @ 7.635 cents	235.08		
		cents	
Cr. Soaking — Tram,		1,656 lb.@ 4.088	$ 67.70
Soaking — Organzine,		3,079 lb.@ 4.088	125.85
Winding — Tram,		1,656 lb.@ 9.997	165.55
Winding — Organzine,		3,079 lb.@ 9.997	307.83
Spinning — Tram,		1,656 lb.@ 9.592	158.85
Spinning — Organzine,		3,079 lb.@11.507	354.31
Reeling — Tram,		1,656 lb.@ 6.419	106.30
Reeling — Organzine,		3,079 lb.@ 6.419	197.62
Shipping — Tram,		1,656 lb.@ 1.727	28.61
Shipping — Organzine,		3,079 lb.@ 1.727	53.17
Operating — Tram,		1,656 lb.@ 7.588	125.66
Operating — Organzine,		3,079 lb.@45.530	1,400.07
Office — Tram,		1,656 lb.@ 2.476	41.00
Office — Organzine,		3,079 lb.@ 2.476	76.23
General — Tram,		1,656 lb.@ 7.635	126.43
General — Organzine,		3,079 lb.@ 7.635	235.08
Dr. Accounts Receivable		4,072.60	
Cr. Sales — Tram,		1,656 lb.@ $0.60	993.60
Sales — Organzine,		3,079 lb.@ 1.00	3,079.00
Dr. Profit and Loss		3,570.26	
		cents	
Cr. Cost of Sales — Tram,		1,656 lb.@ 49.522	820.10
Cost of Sales — Organzine,		3,079 lb.@ 89.379	2,750.16
Dr. Sales — Tram,		1,656 lb.@ 60.000	993.60
Sales — Organzine,		3,079 lb.@100.000	3,079.00
Cr. Profit and Loss,			4,072.60
Dr. Profit and Loss,		502.34	
Cr. Surplus			502.34
		$15,788.06	$15,788.06

LEDGER

Dr. **Soaking — Tram** *Cr.*

Jan. 1	Inventory	$ 19.52	Jan. 31	Inventory, 807 lb. @ 4.088	$ 32.99
" 31	Purchases	48.70	" "	Cost of Sales, 1,656 lb. @ 4.088	67.70
" "	Payroll	32.47			
		$100.69			$100.69

Dr. **Soaking — Organzine** *Cr.*

Jan. 1	Inventory	$ 43.19	Jan. 31	Inventory, 1,783 lb. @ 4.088	$ 72.89
" 31	Purchases	93.30	" "	Cost of Sales, 3,079 lb. @ 4.088	125.85
" "	Payroll	62.25			
		$198.74			$198.74

Dr. **Winding — Tram** *Cr.*

Jan. 1	Inventory	$ 45.70	Jan. 31	Inventory, 543 lb. @ 9.997	$ 54.28
" 31	Payroll	174.13	" "	Cost of Sales, 1,656 lb. @ 9.997	165.55
		219 83			$219.83

Dr. **Winding — Organzine** *Cr.*

Jan. 1	Inventory	$122.14	Jan. 31	Inventory, 1,418 lb. @ 9.997	$141.76
" 31	Payroll	327.45	" "	Cost of Sales, 3,079 lb. @ 9.997	307.83
		$449.59			$449.59

Dr. **Spinning — Tram** *Cr.*

Jan. 1	Inventory	$ 4.93	Jan. 31	Inventory, 218 lb. @ 9.592	$ 20.91
" 31	Payroll	174.83	" 31	Cost of Sales, 1,656 lb. @ 9.592	158.85
		$179.76			$179.76

Dr. **Spinning — Organzine** *Cr.*

Jan. 1	Inventory	$ 78.79	Jan. 31	Inventory, 547 lb. @ 11.507	$ 62.94
" 31	Payroll	338.46	" 31	Cost of Sales, 3,079 lb. @ 11.507	354.31
		$417.25			$417.25

Dr. — Reeling — Tram — Cr.

Jan. 31	Purchases	$ 7.24	Jan. 31	Cost of Sales, 1,656 lb. @ 6.419	$106.30
" "	Payroll	99.06			
		$106.30			$106.30

Dr. — Reeling — Organzine — Cr.

Jan. 31	Purchases	$ 10.00	Jan. 31	Cost of Sales, 3,079 lb. @ 6.419	$197.62
" "	Payroll	187.62			
		$197.62			$197.62

Dr. — Shipping — Tram — Cr.

Jan. 31	Freight	$20.11	Jan. 31	Cost of Sales, 1,656 lb. @ 1.727	$28.61
" "	Payroll	8.50			
		$28.61			$28.61

Dr. — Shipping — Organzine — Cr.

Jan. 31	Freight	$37.17	Jan. 31	Cost of Sales, 3,079 lb. @ 1.727	$53.17
" "	Payroll	16.00			
		$53.17			$53.17

Dr. — Operating Expense — Cr.

Jan. 31	Repairs and Renewals	$ 123.40	Jan. 31	Cost of Sales: Tram, 1,656 lb. @ 7.588	$ 125.66
" "	Fuel	353.65			
" "	Payroll, Superintendent	91.00			
" "	" Machinist	73.72		Organzine, 3,079 @ 45.530	1,400.07
" "	" Watchman	56.62			
" "	" Engineer and Fireman	89.45			
" "	" General Help	181.46			
" "	Depreciation, Buildings	136.53			
" "	" Machinery and Equipment	419.90			
		$1,525.73			$1,525.73

Dr. — Office Expense — Cr.

Jan. 31	Postage	$ 42.00	Jan. 31	Cost of Sales: Tram, 1,656 lb. @ 2.476	$ 41.00
" "	Stationery and Supplies	28.03			
" "	Payroll	45.00		Organzine, 3,079 @ 2.476	76.23
" "	Depreciation on Office Equipment	2.20			
		$117.23			$117.23

Dr. — General Expense — Cr.

Jan. 31	Insurance	$ 56.51	Jan. 31	Cost of Sales: Tram, 1,656 lb. @ 7.635	$126.43
" "	Taxes	5.00			
" "	New York Office	300.00		Organzine, 3,079 @ 7.635	235.08
		$361.51			$361.51

Dr. — Cost of Sales — Tram — Cr.

Jan. 31	Soaking, 1,656 lb. @ 4.088	$ 67.70	Jan. 31	Profit and Loss, 1,656 lb. @ 49.522	$820.10
" "	Winding, " " " 9.997	165.55			
" "	Spinning, " " " 9.592	158.85			
" "	Reeling, " " " 6.419	106.30			
" "	Shipping, " " " 1.727	28.61			
" "	Operating, " " " 7.588	125.66			
" "	Office, " " " 2.476	41.00			
" "	General, " " " 7.635	126.43			
	49.522	$820.10			$820.10

Dr. — Cost of Sales — Organzine — Cr.

Jan. 31	Soaking, 3,079 lb. @ 4.088	$ 125.85	Jan. 31	Profit and Loss, 3,079 lb. @ 89.379	$2,750.16
" "	Winding, " " " 9.997	307.83			
" "	Spinning, " " " 11.507	354.31			
" "	Reeling, " " " 6.419	197.62			
" "	Shipping, " " " 1.727	53.17			
" "	Operating, " " " 45.530	1,400.07			
" "	Office, " " " 2.476	76.23			
" "	General, " " " 7.635	235.08			
	89.379	$2,750.16			$2,750.16

Dr. — Sales — Tram — Cr.

Jan. 31	Profit and Loss	$993.60	Jan. 31	Accounts Receivable, 1,656 lb. @ $0.60	$993.60

Dr. — Sales — Organzine — Cr.

Jan. 31	Profit and Loss	$3,079.00	Jan. 31	Accounts Receivable, 3,079 lb. @ $1.00	$3,079.00

Dr. — Accounts Receivable — Cr.

Jan. 31	Sales	$4,072.60			

Dr. — Profit and Loss — Cr.

Jan. 31	Cost of Sales — Tram, 1,656 lb. @ 49.522	$ 820.10	Jan. 31	Sales — Tram, 1,656 lb. @ 60	$ 993.60
	Cost of Sales — Organzine, 3,079 lb. @ 89.379	2,750.16		Sales — Organzine, 3,079 lb. @ $1.00	3,079.00
	Surplus	502.34			
		$4,072.60			$4,072.60

Dr. — Surplus — Cr.

Jan. 1	Inventory	$314.27
" 31	Profit and Loss	502.34
		$816.61

Dr. — Accounts Payable — Cr.

Jan. 31	Purchases	$763.60

Dr. — Payrolls — Cr.

Jan. 31	Payrolls	$1,958.02

Dr. — Reserve for Depreciation on Buildings — Cr.

Jan. 31	Operating Expense	$136.53

Dr. — Reserve for Depreciation on Machinery and Equipment — Cr.

Jan. 31	Operating Expense	$419.90

Dr. — Reserve for Depreciation on Office Equipment — Cr.

Jan. 31	Office Expense	$2.20

Dr. — Insurance Prepaid — Cr.

Jan. 31	General Expense	$56.51

Dr. — Taxes Accrued — Cr.

Jan. 31	General Expense	$5.00

Dr. — A. B. Co. — Cr.

Jan. 31	General Expense	$300.00

The following trial balance is taken off from the books to prove the accuracy of the postings:

Trial Balance, January 31, 1920

Soaking — Tram, 807 lb. @ 4.088	$32.99	
Soaking — Organzine, 1,783 " " 4.088	72.89	
Winding — Tram, 543 " " 9.997	54.28	
Winding — Organzine, 1,418 " " 9.997	141.76	
Spinning — Tram, 218 " " 9.592	20.01	
Spinning — Organzine, 547 " " 11.507	62.94	
Total Inventory of Work in Process	$385.77	
Accounts Receivable	$4,072.60	
Payrolls		$1,958.02
Reserve for Depreciation on Buildings		136.53
Reserve for Depreciation on Machinery and Equipment		419.90
Reserve for Depreciation on Office Equipment		2.20
Insurance		56.51
Taxes Accrued		5.00
A. B. Co.		300.00
Accounts Payable		763.60
Surplus		816.61
Total	$4,458.37	$4,458.37

We can now make an analysis of the cost of sales and a Profit and Loss account, as shown by the following Exhibits I and II. It will be seen by referring to Exhibit I that tram cost 49.522 cents per pound and organzine 89.379 cents per pound to manufacture. The total profit on tram amounts to $173.50 and on organzine to $328.84 as shown by Exhibit II.

EXHIBIT I

Analysis of Cost of Sales

Cost of Tram

Soaking,	1,656 lb. @	4.088	$ 67.70
Winding,	1,656 lb. @	9.997	165.55
Spinning,	1,656 lb. @	9.592	158.85
Reeling,	1,656 lb. @	6.419	106.30
Shipping,	1,656 lb. @	1.727	28.61
Operating,	1,656 lb. @	7.588	125.66
Office,	1,656 lb. @	2.476	41.00
General,	1,656 lb. @	7.635	126.43
		49.522	$ 820.10

ANALYSIS OF COST OF SALES — *Continued*

Cost of Organzine

Soaking,	3,079 lb. @	4.088	$ 125.85
Winding,	3,079 lb. @	9.997	307.83
Spinning,	3,079 lb. @	11.507	354.31
Reeling,	3,079 lb. @	6.419	197.62
Shipping,	3,079 lb. @	1.727	53.17
Operating,	3,079 lb. @	45.530	1,400.07
Office,	3,079 lb. @	2.476	76.23
General,	3,079 lb. @	7.635	235.08
		89.379	$2,750.16
Grand Total Cost of Sales			$3,570.26

618. Cost of Thrown Silk.— In order to obtain the cost of thrown silk 't is necessary to add the cost of raw silk to the cost of throwing.

EXHIBIT II

PROFIT AND LOSS ACCOUNT

	Tram		Organzine	
	Pounds	Amount	Pounds	Amount
Sales	1,656 @ 60	$993.60	3,079 @ $1.00	$3,079.00
Cost of Sales	1,656 @ 49.522	820.10	3,079 @ 89.379	2,750.16
Profit	10.478	$173.50	20.621	$ 328.84

Profit on Tram	$173.50
Profit on Organzine	328.84
Total profit	$502.34

The cost of sales is shown in the form of an administrative statement in Exhibit III. It is prepared from the Ledger account.

EXHIBIT III

COST OF SALES

Inventory, January 1, 1918				314.27
Direct Charges:				
Soaking, Tram:				
Purchases	$48.70			
Payroll	32.47	$ 81.17		
Soaking, Organzine:				
Purchases	$93.30			
Payroll	62.25	$155.55	$236.72	
Carried Forward			$236.72	$314.27

COST OF SALES — *Continued*

Brought Forward			$236.72	$314.27
Winding, Tram:				
Payroll		$174.13		
Winding, Organzine:				
Payroll		327.45	501.58	
Spinning, Tram:				
Payroll		$174.83		
Spinning, Organzine:				
Payroll		338.46	513.29	
Reeling, Tram:				
Purchases	$ 7.24			
Payroll	99.06	$106.30		
Reeling, Organzine:				
Purchases	$10.00			
Payroll	187.62	$197.62	$303.92	
Shipping, Tram:				
Freight	$20.11			
Payroll	8.50	$28.61		
Shipping, Organzine:				
Freight	$37.17			
Payroll	16.00	$53.17	$81.78	
Operating Expense:				
Repairs and Renewals		$123.40		
Fuel		353.65		
Payroll:				
Superintendent		91.00		
Machinist		73.72		
Watchman		56.62		
Engineer and Fireman		89.45		
General Help		181.46		
Depreciation, Buildings		136.53		
Depreciation, Machinery and Equipment		419.90	$1,525.73	
Office Expense:				
Postage		$42.00		
Stationery and Supplies		28.03		
Payroll		45.00		
Depreciation, Office Equipment		2.20	$117.23	
General Expense:				
Insurance		$56.51		
Taxes		5.00		
New York Office		300.00	$361.51	$3,641.76
				$3,956.03
Deduct: Inventory of work in process at end of period				385.77
Total Cost of Sales				$3,570.26

The foregoing statements are suggestions of the forms to be followed in preparing reports for any process factory.

Questions on Chapter XLIV

1. What sort of cost system is best adapted to meet the needs of a silk-throwing mill?
2. What is meant by tram and warp?
3. What is the proper Journal entry to set up the initial inventory?
4. At the end of the month what Journal entries should be made to cover the purchases, payroll, depreciation, insurance, and taxes?
5. What procedure is followed in closing the cost accounts? Illustrate.
6. What entry is made at the end of each month covering the cost of sales?
7. Illustrate by means of *pro forma* Ledger accounts how the cost accounts appear in the General Ledger.

INDEX

Account:
  cost of sales, 43, 368, 512
  finished goods, 43
  overhead expense, 42
  raw material, 42
  selling expense, 43
  stores, 144
  supplies, 42
  work in process, 42
    job-order cost system, 377
    process system, 377
Accounting Control:
  expense accounts, 283
Accounting organization chart, 472
Accounting periods, 279
Accounts payable account, shoe factory, 523
Adding and listing machines, 409
Addressograph, 236
Alligation, 179
Analysis of hourly machine expense, 352
Analysis of hourly service costs, job printery, 495
Analysis of sales, 53, 383, 405, 484, 546
Analysis of gross profit on sales, 464
Assembly drawing, 77
Automatic counting, 64
  scale, 121
  sorting machine, 416
  tabulating machine, 416
Average number system of finding cotton yarn costs, 354
Average selling price and average cost, 424, 425

Balance sheet, arrangement of, 397
  in cocoanut factory, 482
  forms, 51, 467, 508
  job printery, 508
  pro-forma account form, 399
  pro-forma report form, 400
Beef packing by-products, 167
Billing and charge system, 384
Bills payable record, 111
Bin tag, 148
Blank part entering partial assemblies, 78
Bonus system, 217
Bottom parts account, shoe factory, 518
Breakage, 123
Building and occupancy expense account, worsted mill, 553
Burden account, cocoanut factory, 481
Burden analysis, cocoanut factory, 475
Burden distribution journal voucher, job printery, 500
By-products, accounting for, 167
  example of cost calculation, 183

Calculagraph, 250
  time card, 251
Calculus, 258, 261
Candied citron and peel, cost system, 458
Card room daily report, 61
Card time recorder, "in" and "out" register, 223
Cartons account, shoe factory, 520
Cash paid book, 110
Charge back invoice, 108
Chargeable, non-chargeable and total hours, 421
Checking card, 230
Classification of machinery, production center method, 338
Clock number card, 225
Cloth organizations, weaving mill costs, 172
Clothing costs, tariff board cost formulas, 26
Cocoanut factory costs, process system, 456

Composing room hours, 422
Comptometer, 408
Containers and coverings, 165
Conversion cost, 275
factors, 176
Cost, elements of, 20, 23
after a gain in weight, calculation of, 185, 186
after a loss in weight, calculation of, 186
of dressed goods, calculation sheet, 178; ostrich feathers, 177
of manufacture, 370
of material mined or quarried, royalties, 170
of ply yarn, 540
of production, entry for, 46
of single yarn, 539
of sorted wool, 534
of thrown silk, 574
of tops, dyed, 537
of tops, white, 535
of a unit of production, 367
of worsted, 542
of worsted fabrics, 543
of yarn, manufacturing cost, 362
of yield, example of cost calculation, 185
Cost, prime, 20
Cost, total, 16
Cost accounts, 40
classifications, 531
chart of, 41
in job-order factories, 486
in trading enterprise, 458
in worsted mill, 546
Cost arithmetic, burden rate calculations, 343; labor expenditures, 255; material expenditures, 175
Cost estimates, checking, 9
Cost formula, variations in, 24
Cost ledger, machine hours method, 377
operation of, 197
percentage on productive labor method, 373
prime cost method, 375
productive hour rate method, 374
Cost ledger, sold hours method, 376
Cost of sales, analysis of, 383
in cocoanut factory, 478, 480
Cost of sales account, 43, 512
in worsted mill, 552
Cost of sales analysis, 463
Cost of sales journal voucher, job printery, 501
Cost of sales statement, 404
Cost record, 90
Cost sheet for shoes, 86, 513
Cost summary forms, 85, 89, 90
Cost system, definition of, 5, 10; why install, 5
check on by inventory, 8
estimating, 510
Cost systems, 453, 455
Costs, bakery, 370
determinations of by United States Government, 25, 26, 27
in garment factories, 510
job-order factory, 372
in job-order system in printery, 7, 456
in manufacturing undertakings, 454
material, 164
newspaper, 7
in process plants, 370, 469
in process system in cocoanut factory, 456
relation of to financial statements, 396
relation of to profits, 12
in shoe factories, 456, 510
in single and multi-process plants, 469
textile, 528
theoretical production, 469
in trading enterprise, 453
in worsted mill, 530
See also Cotton yarn costs.
Cotton purchased and amount paid, ratio chart, 432
Cotton yarn costs, appreciating the values of cotton in yarn, 361
average number system, 354
conversion cost of the average number of yarn reeled, 359

Cotton yarn costs, conversion cost of the average number of yarn spooled, 356
conversion cost of the average number of yarn spun, 354
conversion cost of the average number of yarn twisted, 358
conversion cost of the average number of yarn warped, 360
Counting machines, 120
Custom yarn costs, 541
Customer's ledger, 387
Cutting room record of linings, 139

Daily cash report, 112
Daily time report, 242
Daily time ticket, 249
in job printery, bindery, 492; composition department, 490; pressroom, 491
Day sheet system, in shoe factory, 514
Days, payroll, and papers printed, ratio chart, 432
Decimal system of time recording, 243
Departments, examples of, 201
Departmental loss and gain accounts, in job printery, 505
Departmental rates, use of, 276
Departmental processes, system of, 470
Departmentalization, distribution of labor, 200
of payroll, 199
Depletion, cost of material mined or quarried, 170
Depreciation, abnormal, 295
apportionment of, 346
example of, 281
expired capital outlay, 291
fixed proportion method, 296; formula, 299
methods of calculation, 296
obsolesence, 295
percentage on diminishing value method, 297
relation to costs, 15
repairs, 294
sinking fund method, 301
Depreciation, wear and tear, 294
Desk for stores records, 152
Detailed analysis of expense, 326
Deviation above and below the moving average of yards woven and weaving labor, chart, 441
Dial time recorder, 226
Differential wage system, chart showing amounts earned, 214
description of, 213
Dimension list, 140
Direct labor, 21
Dispatching orders, description of system, 82
Distribution of incomes by classes, 439
Distribution of material, 141
Dyeing department labor and expense account, in worsted mill, 552

Elapsed time recorder, calculagraph, 250
Electric time stamp, 247
Emerson efficiency bonus system, 218
Emerson efficiency wage system, example of rate calculation, 269
chart showing amounts earned, 217
Employee's application and record form, 222
Employee's history card, 223
Employee's information blank, 222
Employee's piece work record, 228
for weekly earnings, 229
Estimate sheet, 488
Estimating cost system, 510
Expense, analysis of, 326; hourly machine, 351
apportionment of, depreciation, 346; insurance, 346; light, 347; power, 347; rent, 346; building and occupancy, 320
chart of accounts, 278
current charges to, 285
departmentalization of, 274
distribution of overhead, 329

Expense, engineering and shafting, 27
factory administration, 348
factory burden, 329
fixed charges, 345
general and office, 323
junk department, 168
lighting, 322
loss on broken bricks, 288
loss on defective castings, 288
non-productive labor chargeable to, 344
overhead in job-order factories, 275
power, 319
prepaid and accrued charges, 291
production chargeable to, 288
purchases chargeable to, 286, 344
repairs, 319
selling, 16, 24, 277, 341
spoilage and lost time chargeable to, 345
statement of, 327
supplies chargeable to, 287
transport service, 323
See also Overhead.
Expense accounting, basis of, 281
Expense burden account, *pro-forma* account, 505
Expense ledger, 279
Expense rates, 274
Expired capital outlay, depreciation, 291

Fabrics, organization of, 530
Factory administration, apportionment of, 348
Factory burden, distribution of expense, 329
Factory expense account, shoe factory, 524
Factory journal, entries, 45, 46
Factory ledger, 390
control of, 390
description of, 43
method of controlling, 44
trial balance, 47
Factory organization, departmentalization of, 198
Factory overhead, 21
Financial statements, 396
Findings account, shoe factory, 519
Finished goods, *pro-forma* account, 381
account, description of, 43, 380; cocoanut factory, 480
sold, entry for, 46
stock ledger, 49, 50
stock record, 151
Fixed charges, chargeable to expense, 345
entry for, 46
examples of, 22
Fixed proportion method, chart showing depreciated value, 296
Floor space, chart of, 321
Foundry daily production record, 63
Frequency table, 445

Gain in weight, accounting for, 168
Gantt task and bonus system, chart showing amounts earned, 217
description of, 217
example of rate calculation, 268
General and office expense, apportionment of, 323
account, worsted mill, 553
General ledger, 465
account, shoe factory, 526
cost accounts, cocoanut factory, 479
trial balance, 466
Goods packed and supplies used, cocoanut factory, 477
Graphic charts, use of in cost work, 419

Halsey premium, wage system, 214
wage system, chart showing amounts earned per hour, 215
example of rate calculation, 265, 266
Hours and impressions, web presses, 431
Hour rate, wage system, 210
Hourly burden rates, example of calculation of, 349
Hourly machine expense, analysis of, 351

Hours, payroll, and average amount of payroll ratio chart, 429

Idle machinery, unused capacity, 282
Indirect labor, definition of, 285
Individual job time tickets, 242, 246
Individual order cost, job printery, 496
sheet, 88
Individual part needed by assembly foreman, 78
Insurance, apportionment of, 346
prepaid account, worsted mill, 554
unexpired account, shoe factory, 523
Interest, 315
comparison with cost of outside service, 317
rent *vs.*, 316
Inventory, check on, 8
control of, 152
controlling accounts, 47
fixing responsibility for, 118
instructions for taking, 161
relation to costs, 13, 14
supplies, 157
of sole leather in process, 161
of work in process, job printery, 497
sheet with coupon, 160
of supplies sheet, 159
tags, 58, 59, 157, 158
Inventories, perpetual, 144
physical, 156
raw material, work in process, and finished goods, 369
Investment yield, 316
Invisible waste, accounting for, 165; in foundries, 182
illustrative case, 166
Invoice to customer, 385, 462
Iron foundry, distribution of overhead, 340

Job costs, predetermined, 510
Job time ticket, 247
Job order, job order *vs.* process plants, 17
costs, examples, 32
Job order, system, chart, 37
factory, furniture factory, 197
factories, distribution of labor, 197
distribution of overhead, 330
system, textile mill, 529
Journal, cocoanut factory, 479
entries, general ledger, 392
entries, factory ledger, 45, 46
entries, silk, mill, 565
entries worsted mill 556
voucher, 465
Junk department expense, accounting for, 168

Key punch, use of in cost work, 415

Labor, time work, 195
direct, 21
distribution of, 196, 197
elements of cost, 195
piecework, 195
wage systems, 209
Labor distribution journal voucher, job printery, 499
Labor and expense, chart showing, 424
Labor cost record, 241
Labor costs, 241
Labor punch card, 414
Lasts and patterns account, shoe factory, 520
Leakage, accounting for, 123
Ledger, factory, 43
accounts, *pro-forma* accounts, 392, 393
shoe factory, 516
Light, apportionment of, 347
Lighting expense, distribution of, 322
Logarithms of numbers, 427
Loom-day system, distribution of overhead, 340
Loss and gain account, job printery, 507
Loss and gain on estimates, accounting for, 168
Loss and gain journal voucher, job printery, 502

Loss and gain on tops account, worsted mill, 548
Loss and gain on upper leather estimates account, shoe factory, 517
Loss and gain on yarn account, worsted mill, 549
Losses, detection of, 8
Lot number system, stores system, 147

Machine hours, cost ledger, 377
Machinery and equipment account, shoe factory, 522
Machinery record, 293
Make ready, running, chargeable time, ratio chart, 430
Manifold orders, 386
Manufacturing account, *pro-forma* account, 504
Manufacturing cost analysis, cocoanut factory, 476
Margins of error, 164
Material, cost calculations, 164
  raw, 21
  cost calculations, examples of, 95
  costs, introduction to, 95
  standardized, 512
Maximum and minimum limits, stores control, 149
  stores system, 122
Mechanical aids in cost work, devices for calculations, 408
Memorandum of heels used in shoe factory, 139
Millwork, by-products, 167
Mixtures, accounting for, 171
Moving average of yards and labor, 440

Newspaper costs, 508
  accounting for, 113
Newton's binomial theorem, 444
Noil and waste account, worsted mill, 551
Non-productive labor, chargeable to expense, 344
Normal curve of error, chart 446
  frequency distribution, 442

Obsolesence, depreciation, 295
Operation index, 80
Operator's time ticket, 244
Operator's time record, 252
Organization, charts, 201
  in jewelry factory, 205
  in job printery, 203
  in machine shop and assembling plant, 206
  in silk-throwing mill, 201
  in worsted mill, 207
Ostrich feather plumes, cost of, 177
Overhead, cost arithmetic connected with burden rate calculations, 343
  distribution of in automatic machine departments, 336; in a cannery, 340; in carriage factories, 334; in iron foundry, 340; in job-order factories, 330; in job-printing industry, 335; in marble industry, 334; in paper mills, 336; in process plants, 329
  factory, 21
  Federal Trade Commission's recommendations, 333
  hourly burden rates in an optical goods factory, 343
  loom-day system, 340
  percentage on prime cost method, 334
  percentage on productive-labor labor method, 330
  production-center method (machine hours), 337
  productive-hours method, 333
  quantity of output method, 340
  sold-hours method, 335
  Tariff Board system of distribution in textile industry, 340
  See also Expense.
Overhead expense, entry for, 46
  introduction to, 273
  account, 42
Overtime, accounting for, 211
  payroll for showing, 235

Payroll, 233, 234
  analysis, 200, 239; sheet, 532

Payroll, departmentalization of, 199
  entry for, 46
  example of calculation, 264
  for use of addressograph, 237
  job printery, composition department, 493
  overtime, 235
Payroll account, cocoanut factory, 480
  pro-forma account, 505
  shoe factory, 525
  worsted mill, 555
Payroll, calculation sheet, 258, 260
  distribution, cocoanut factory, 475
  hours, cylinder press department, 421; chart showing, 420
  and hours in composing room, ratio chart, 433, 434
  and papers printed, 433
  strip, for dial time recorder, 227
Payrolls, 221
  control of, 196
Pea cannery, accounting for, 113
Percentage of employees at each five dollar range of weekly compensation, 446
Percentage of gain, loss and yield, example of cost calculation, 184
Percentage of labor burden rates, example of calculation of, 350
Percentage on diminishing value method, chart showing depreciation value, 297
Percentage on prime cost method, distribution of overhead expense, 334
Percentage on productive labor method, cost ledger, 373
  distribution of overhead expense, 330
Pearsonian coefficient of correlation, 443
Petty cash voucher, 105
Physical inventories, 156
Piecework, card, 232
  checking card, 230
  discussion of, 195
  example of rate calculation, 263

Piecework, rates, 258
  ticket with coupon, 231
  working sheet, 233
Piecework system, calculation of rate, 212
  fixing rates, 211
  wage system, 211
Piecework ticket with coupon, 231
Planning board, production control, 82
Plant ledger, 292
Plant records, arrangement of, 293
Plant values, 316
Power, apportionment of, 347
  distribution of, 320
Power expense account, worsted mill, 553
Premium wage system, chart showing amounts earned, 216
  Halsey wage, 214
Prepaid and accrued charges, 279
Prepared cocoanut costs, 470
Prime cost, 20
Prime cost method, cost ledger, 375
Process costs, problem, 562
Process cost system, chart, 35
  departmental accounts, 378
Process plants, costs in extractive industries, 30
  distribution of labor, 196
  distribution of overhead, 329
  material used in, 116
  vs. job plants, 17; examples, 17
Process system, production report, 61
  textile mill, 529
Production, and costs, 30
  labor, and expense, chart, 428; in weaving mill, 423
Production center method (machine hours), distribution of overhead expense, 337
Production (finished goods) account, *pro-forma* account, 504
Production journal voucher. job printery, 501
Production order, for shoes, 68; in job printery, 66
Production orders, classification of, 65; in job-order factories, 65;

Production orders, classification of, in ostrich-plume factory, 71, 72. 73, 74, 75
record, 62
Production records, 59
Production sales, costs and operating profit, chart showing, 248
Production system, in assembling industries, 81
Productive hour method, cost ledger, 374
distribution of overhead expense, 333
Profit, definition of, 4
interest, 315
what lines to push, 6
and loss, factory, 512
and loss account, 52, 467; arrangement of, 397; in cocoanut factory, 483; manufacturing section, 368; in shoe factory, 525; trading section, 368
Profit and loss statement, 404
Profits, departmentalization of, 5
Proof of accuracy in punching, 416
Punch card, 411
labor, 414
stores issued, 412
Punching machine, use of in cost work, 415
Purchase, specifications, 99
Purchase journal, 107, 108
Purchase order, 104, 459
specifications, example of, 100
Purchasing and voucher system, 99
Purchasing records, 100
Purchasing system, 97
Purchases, chargeable to expense, 344
entry for, 45

Quantity of output method, distribution of overhead, 340
Quotation record, 101

Ratio charts, description of, 419
in general, 425
Raw material, cost of, 164
definition of, 21
returned to stock, 142
Raw material account, cocoanut factory, 480; description of, 42; *pro-forma* account, 504
Raw material index, 79
Raw material report, cocoanut factory, 474
Raw material requisition, entry for, 46
Raw material stores ledger, 47
Raw stores record. lot system, 151
Rebates, 164
Recapitulation of sales, 387
Receiving record, for stores, 133
Record of productive and non-productive hours, job printery, 493
and press impressions, 494
Record of raw hides issued, 136
Refinings, accounting for, 165
Remainder values corresponding to several fixed rates of increase and decrease, 435, 437
ratio chart, 436
double ratio chart, 436
Remnants. example of a cost calculation, 187
Rent, apportionment of, 346
Repair department, labor and expense account, worsted mill, 552
Repairs, accounting for, 319
depreciation, 294
Report of cotton opened, daily report, 135
Report of stores issued, 533
Repricing graded material, 178
Requisition, job printer, 489
upper leather, 511
on purchasing agent, 103
on storekeeper, 137
on stores, 460
Reserve for depreciation account, shoe factory, 520, 522
Royalties, cost of material mined or quarried, 170
Royalties accrued account, shoe factory, 524

Rowan premium wage system, chart showing amounts earned, 216
example of rate calculation, 267

Sales account, worsted mill, 552
Sales analysis, 388, 463
Sales book, 387
Sales distribution journal voucher, job printery, 502
Scrap, value of, 295
Scraps and cuttings, accounting for, 165
Selling expense, 16
definition of, 24, 277
in cocoanut factory, 485
ratio to sales and cost, 341
account, description of, 43; *pro-forma* account, 505
Service department, 276
expense, apportionment of, 319
Services, examples of, 22
Shipping order, 460
Shoe factory, accounts, 513
processes, 514
Shoe tag, 515
Shoes. classification of, 513
Shrinkages, 164
Silk industry, gain in weight, 168
Silk mill costs, problem, 562
Sinking fund method, chart showing depreciated value, 301
Sold-hour cost system, printer's system, 487
Sold-hours burden rate, example of calculation of, 351
Sold-hours method, cost ledger, 376
distribution of overhead expense, 335
Sorting and grading material, repricing of, 170
Spoilage and lost time, chargeable to expense, 345
"Square-Turn" farm tractor, 81
Standing expense orders, distribution of labor, 197
Statement of overhead expense, 327
Steel industry costs, United States Government cost formulae, 25
Stock list, 76
Stock memorandum, 138
Stock record, 461
Stock record showing quantities only, 150
with paid duty feature, 153
Stock records, card *vs.* loose leaf, 145
money value shown, 146
Storehouse, organization of, 117
Stores, arrangement of, 119
bin arrangement, 120; bin tag, 148
block system of classification, 126
breakage in, 123
classification of, 125; combination of letters and numbers, 129; mnemonic symbols, 128; use of "base sheet," 129
classification systems, 126
control, 97
cutting room record of linings. 139
daily report of stock issued, 135
desk for stock record cards, 152
Dewey decimal system, 126; example of, 128
dimension list, 140
distribution of material, 141
directory of, 121
equipment for storehouse, 120
expense of, 123
finished goods stock record, 151
identification of, 121
inventory instructions, 161
inventory of sole leather in process, 161
inventory of supplies sheet, 159
inventory sheet with coupon, 160
inventory tags, 158
investment in, 146
leakage in, 123
location of, 118
location of ledger, 147
maximum and minimum limits, 122
memorandum of heels used in shoe factory, 139
Stores organization, 114
perpetual inventories, 144
raw stores record for lots, 151
record of raw hides issued, 136

Stores organization, record of stock issued, 134
receiving record, 133
report of cotton opened, 135
requests for stock, 132
requisition on storeskeeper, 137
routine of receipt and issue, 132
small tools records, 152
special containers, 120
stock record showing quantities only, 150
stock record with paid duty feature, 153
stock memorandum, 138
symbols, 125
turnover, 122
upper leather tag, 147
use of automatic scale, 121
waste in, 123
account, worsted mill, 546
distribution journal voucher, job printery, 498
issued punch card, 412
ledger, cocoanut factory, 473
Storeskeeping, examples of, 125
Style number index card, in ostrich plume factory, 70
Subsidiary expense ledger, 279
Sundry accounts journal voucher, job printery, 499
Supervision, apportionment of, 9, 323
Supplies account, description of, 42
cocoanut factory, 480
pro-forma account, 504
shoe factory, 516
Supplies requisitions, entry for, 46
Symbols, stores, 125

Table of conversion factors, 176
Table showing cost of tops, middles and unders, 179
Take-up in twisting rope, accounting for, 171
Take-up in weaving, accounting for, 170
example of a cost calculation, 187
Tanners, by-product, 167
Taylor differential wage system, description of, 213
Taylor differential wage system, example of rate calculation, 264
Taxes prepaid account, worsted mill, 554
Textile calculations, cotton industry, 173
numbering systems, 187
Textile costs, 528
example of, 33
special system, 456
Theoretical production, relation to costs, 469
Time clock cards, 225
Timekeeping systems, description of, 223
functions of, 221
Time recording devices, 198
Timework, disadvantages of, 195
Tool records, small tools system, 152
Tops account, worsted mill, 547
Total cost, in shoe factory, 87
Transport service, apportionment of, 323
Trial balance, 50
factory and general ledger, 390
factory ledger, shoe factory, 526
of factory ledger, 47
pro-forma, 391
of worsted mill, 555
Trimmings and linings account, shoe factory, 519
Turnover, 315
stores, 122

Upper leather tag, 147
Upper stock account, shoe factory, 517

Vendor's record, 102
Voucher checks, 109
Voucher stamp, 106

Wage systems, 209
Emerson efficiency wage system, 217
Gantt task and bonus system, 217
Halsey premium wage system, 214
hour rate system, 210
piecework system, 211
premium wage system, 216

Wage systems, Taylor differential, 213
Waste, accounting for, 119, 123; in lumber cutting, 166; in non-ferrous metal foundry, 181
elimination of, 4
products in woolen and worsted mills, accounting for, 182; example of cost calculation, 182
sales, entry for, 46
Wear and tear depreciation, 294
Weaving mill costs, Tariff Board cost formulae, 27
Weekly operation report of coats, 253
Wood pulp, accounting for, 114
Wool, cost of sorted, 183, 534
cost of tops, 534
account, worsted mill, 547
mixture, alligation, 180
Woolen industry, accounting for sorting and grading, 170
Working sheet, 233
Work in process, *pro-forma* account, 378
Work in process, account, cocoanut factory, 480; description of, 42; job-order cost system, 377; *pro-forma* account in process factory, 379; process cost system, 377; shoe factory, 521
ledger, 49
Worsted account, worsted mill, 550
Woven and knit fabrics, 528

Yarn, cost of making, 538
example; finding cotton count corresponding to worsted count, 189; finding the worsted count, 189; finding the linen count, 189; finding cotton count corresponding to woolen count, 189; finding the cotton count, 188
numbering system, 529
ply, 528
production of, 262
account, worsted mill, 548
Yield, accounting for, 167

Date Due

Nov 4			
OCT 21 1943			
26			
May 10			

MHS 05809

JAN 30 1995 NEH

JUN 13 1921

COLUMBIA UNIVERSITY LIBRARIES
0044241631

D460 E352

Eggleston

Business costs

OCT 8 1924

DEC 19 1924

1455 Bryant Av. N.Y.C.

Leon Badler March 5 1926

MAR 9 1926

renewed

MAR 26 1926

renewed

APR 6 1926

Leon Badler

1455 Bryant Av.

N.Y.C.

APR 30 1926

MAY 13 1926

Renewed

renewed 1926

JUN 3 1926

C.C
SER
COM

END OF
TITLE